education sciences

Contemporary Teacher Education

A Global Perspective

Edited by
Kirsi Tirri

Printed Edition of the Special Issue Published in *Education Sciences*

www.mdpi.com/journal/education

MDPI

Contemporary Teacher Education: A Global Perspective

Contemporary Teacher Education: A Global Perspective

Editor

Kirsi Tirri

MDPI • Basel • Beijing • Wuhan • Barcelona • Belgrade • Manchester • Tokyo • Cluj • Tianjin

Editor
Kirsi Tirri
Faculty of Educational Sciences
University of Helsinki
Helsinki
Finland

Editorial Office
MDPI
St. Alban-Anlage 66
4052 Basel, Switzerland

This is a reprint of articles from the Special Issue published online in the open access journal *Education Sciences* (ISSN 2227-7102) (available at: www.mdpi.com/journal/education/special_issues/Contemporary_teacher).

For citation purposes, cite each article independently as indicated on the article page online and as indicated below:

LastName, A.A.; LastName, B.B.; LastName, C.C. Article Title. *Journal Name* **Year**, *Volume Number*, Page Range.

ISBN 978-3-0365-1690-5 (Hbk)
ISBN 978-3-0365-1689-9 (PDF)

Contents

About the Editor . . . . . **vii**

Kirsi Tirri
Contemporary Teacher Education: A Global Perspective-Introduction to a Special Collection of Research
Reprinted from: *Education Sciences* **2021**, *11*, 340, doi:10.3390/educsci11070340 . . . . . **1**

Terence Lovat
Holistic Learning Versus Instrumentalism in Teacher Education: Lessons from Values Pedagogy and Related Research
Reprinted from: *Education Sciences* **2020**, *10*, 341, doi:10.3390/educsci10110341 . . . . . **3**

Elina Kuusisto and Kirsi Tirri
The Challenge of Educating Purposeful Teachers in Finland
Reprinted from: *Education Sciences* **2021**, *11*, 29, doi:10.3390/educsci11010029 . . . . . **15**

Saija Benjamin, Visajaani Salonen, Liam Gearon, Pia Koirikivi and Arniika Kuusisto
Safe Space, Dangerous Territory: Young People's Views on Preventing Radicalization through Education—Perspectives for Pre-Service Teacher Education
Reprinted from: *Education Sciences* **2021**, *11*, 205, doi:10.3390/educsci11050205 . . . . . **27**

Toni Mäkipää and Raili Hildén
What Kind of Feedback is Perceived as Encouraging by Finnish General Upper Secondary School Students?
Reprinted from: *Education Sciences* **2021**, *11*, 12, doi:10.3390/educsci11010012 . . . . . **45**

Pihel Hunt, Äli Leijen and Marieke van der Schaaf
Automated Feedback Is Nice and Human Presence Makes It Better: Teachers' Perceptions of Feedback by Means of an E-Portfolio Enhanced with Learning Analytics
Reprinted from: *Education Sciences* **2021**, *11*, 278, doi:10.3390/educsci11060278 . . . . . **61**

Cristiana Levinthal, Elina Kuusisto and Kirsi Tirri
Finnish and Portuguese Parents' Perspectives on the Role of Teachers in Parent-Teacher Partnerships and Parental Engagement
Reprinted from: *Education Sciences* **2021**, *11*, 306, doi:10.3390/educsci11060306 . . . . . **75**

Anne-Mari Kuusimäki, Lotta Uusitalo and Kirsi Tirri
Predictors of Parental Contentment with the Amount of Encouraging Digital Feedback from Teachers in Finnish Schools
Reprinted from: *Education Sciences* **2021**, *11*, 253, doi:10.3390/educsci11060253 . . . . . **91**

Ismo T. Koponen
Nature of Science (NOS) Being Acquainted with Science of Science (SoS): Providing a Panoramic Picture of Sciences to Embody NOS for Pre-Service Teachers
Reprinted from: *Education Sciences* **2021**, *11*, 107, doi:10.3390/educsci11030107 . . . . . **103**

Outi Haatainen, Jaakko Turkka and Maija Aksela
Science Teachers' Perceptions and Self-Efficacy Beliefs Related to Integrated Science Education
Reprinted from: *Education Sciences* **2021**, *11*, 272, doi:10.3390/educsci11060272 . . . . . **133**

Jaana Kristiina Herranen, Maija Katariina Aksela, Maya Kaul and Saara Lehto
Teachers' Expectations and Perceptions of the Relevance of Professional Development MOOCs
Reprinted from: *Education Sciences* **2021**, *11*, 240, doi:10.3390/educsci11050240 . . . . . **153**

Auli Toom, Kirsi Pyhältö, Janne Pietarinen and Tiina Soini
Professional Agency for Learning as a Key for Developing Teachers' Competencies?
Reprinted from: *Education Sciences* **2021**, *11*, 324, doi:10.3390/educsci11070324 . . . . . **165**

About the Editor

Kirsi Tirri

Dr. Kirsi Tirri is a full Professor of Education at the Faculty of Educational Sciences at the University of Helsinki and a visiting Professor at St. John's University, New York, USA. Professor Tirri was President of ECHA (European Council for High Ability) in 2008–2012 and President of the Finnish Academy of Science and Letters in 2016–2017. Her research interests include school pedagogy, moral and religious education, gifted education, teacher education, and cross-cultural studies. She has published 13 monographs and numerous journal articles related to these fields.

education sciences

MDPI

Editorial

Contemporary Teacher Education: A Global Perspective-Introduction to a Special Collection of Research

Kirsi Tirri

Faculty of Educational Sciences, University of Helsinki, Yliopistonkatu 4, 00100 Helsinki, Finland; kirsi.tirri@helsinki.fi

This special issue on "Contemporary Teacher Education: A Global Perspective" contains eleven articles focused on varied current topics in teacher education all over the world. We take a holistic approach to teacher education and argue that the purpose of education is to educate the whole personality of a teacher including cognitive, social, and moral domains [1,2] This kind of approach should be implemented in both pre-service and in-service teacher education. We need more research on teachers' values, beliefs and attitudes that influence their motivation to learn new things and develop in their profession. We also need research on teachers' cognitive and social skills that are important in promoting good teaching and learning. Teachers' skills to meet the needs of different learners and to teach different subjects by integrating and differentiating the subject matter are global challenges [3]. The opportunities and problems related to variety of digital technologies and social media create challenges for teachers to support student learning on different cultures and values with critical minds.

Lifelong learning is one of the aims for twenty-first century teachers. A pedagogically competent teacher pays attention to her students' abilities, gender, prior knowledge, motives, and expectations to make learning meaningful for them [4]. Teamwork and co-operation among teachers, with homes and other institutions are necessary to provide the best possible education for our students [5]. All these aims and demands create pedagogical challenges in teacher education and call for research-based approaches that can be applied in teacher education programs.

Contributors to this collection of eleven articles reflect global issues in teacher educations originating from Australia, Estonia, Finland, England, Portugal, and Sweden. Their articles address the following questions: How can holistic learning be actualized in teacher education? What are the challenges in education of purposeful teachers? How can violent extremism be prevented through education? What kind of teacher feedback is perceived as encouraging by students? How do teachers perceive peer-feedback through electronic portfolios? How content are parents with the amount of digital feedback they get from schools? How do parents perceive the role of a teacher in teacher-parent partnership? What kind of scientific knowledge do science teachers need to provide high-quality science teaching? How do teachers' perceptions and self-efficacy beliefs are related to integrated science education? How relevant teachers find MOOCs in their professional development?

How can teacher education cultivate student teacher learning in becoming competent and agentic teachers?

The research in this special issue is an international collection of studies focusing on the current challenges and possibilities in teacher education. The contributors examine teacher education with theoretical and empirical approaches including both qualitative and quantitative research methods. The studies demonstrate that future teachers need high-level ethical and pedagogical skills in order to cope with the new challenges in education. With the research-based and holistic approach we can educate good teachers for tomorrow's schools.

Citation: Tirri, K. Contemporary Teacher Education: A Global Perspective-Introduction to a Special Collection of Research. *Educ. Sci.* **2021**, *11*, 340. https://doi.org/10.3390/educsci11070340

Received: 6 July 2021
Accepted: 6 July 2021
Published: 9 July 2021

References

1. Tirri, K. Ethical sensitivity in teaching and teacher education. In *Encyclopedia of Teacher Educations*; Springer: Singapore, 2019.
2. Korthagen, F.A.J. In search of an essence of a good teacher: Towards a more holistic approach in teacher education. *Teach. Teach. Educ.* **2004**, *20*, 77–97. [CrossRef]
3. Tirri, K.; Toom, A. Pedagogy in Basic and Higher Education: Current Developments and Challenges. IntechOpen. 2020. Available online: https://www.intechopen.com/books/pedagogy-in-basic-and-higher-education-current-developments-and-challenges (accessed on 30 June 2021).
4. Bundick, M.J.; Tirri, K. Student Perceptions of Teacher Support and Competencies for Fostering Youth Purpose and Positive Youth Development: Perspectives from Two Countries. *Appl. Dev. Sci.* **2014**, *18*, 148–162. [CrossRef]
5. Kuusimäki, A.-M.; Uusitalo-Malmivaara, L.; Tirri, K. Parents' and teachers' views on digital communication in Finland. *Educ. Res. Int.* **2019**. [CrossRef]

education sciences

MDPI

Article

Holistic Learning Versus Instrumentalism in Teacher Education: Lessons from Values Pedagogy and Related Research

Terence Lovat

Faculty of Education and Arts, The University of Newcastle, Newcastle, NSW 2308, Australia; terry.lovat@newcastle.edu.au

Received: 3 November 2020; Accepted: 18 November 2020; Published: 20 November 2020

Abstract: This article constitutes a literature review, focusing on the idea of holistic learning, as found in key sources, and its essential contrasting with instrumentalist approaches to learning. It will move to explore updated research on holistic learning factors, with special attention to insights gleaned from values pedagogy and the research that underpins it. The article will juxtapose those insights with the instrumentalism that, it will allege, too often dictates teacher education directions. The article will conclude with an argument that teacher education has become, in modern times, a service industry, too often serving the agendas of governments and teacher unions, rather than preparing teachers to follow the guidelines provided by the latest research into student wellbeing and societal betterment. The article will focus especially on a number of Australian examples to mount the argument that nonetheless applies more generally across Western domains.

Keywords: holistic learning; instrumentalism; values pedagogy; teacher education; Australian education

1. Introduction

One can reasonably trace notions of holism in education to the ancient Persians, Arabs and Greeks, and certainly to the great Muslim thinkers of Islam's Golden Age. In more recent times, educational innovators like John Dewey, Maria Montessori, Loris Malaguzzi and Vasily Sukhomlinsky have either laid out the terms of holistic education or constructed exemplar sites that have demonstrated its greater effects. Coming at the issue of learning from a variety of standpoints, from philosophy to early childhood expertise, the common theme is that learning is not a singular function of a separable cognition but rather a phenomenon that derives best from all developmental measures being brought into play.

Modern neuroscience has, in many ways, provided the scientific evidence that supports such holism. Emotionality, sociality, morality, spirituality and the aesthetic senses are not detachments from the learning experience. They are part and parcel of it. The human function we refer to as cognition relies on all of these developmental measures in order to function optimally. Rationality is not apart from these elements of human development but rather part of them, as they are part of it. We think with our feelings, with our social, moral and spiritual impulses, and with our aesthetic senses. In their various ways, the above cultural traditions and scholars understood this holistic truth about learning and, in the case of some of them, founded the learning structures that proved it.

What has all this to do with teacher education is the key research question dealt with in this paper.

2. Instrumentalism in Western Education

The alleged instrumentalist disposition in Western education is well documented as one that afflicts modern regimes of schooling and teacher education [1,2]. It is a turn that defies the most

advanced conceptions of knowledge and the cognitive interests that drive them [3,4], including the indispensable role of imagination [5–8]. It furthermore flies in the face of current directions in the sciences generally [9] and education sciences more specifically [10–13]. The contention in this article is that this instrumentalist turn is not only out of touch with research in the sciences most applicable to education but that it renders Western education, and hence teacher education, less effective than it should be *vis a vis* the goals our society sets for it.

When Syed Muhammad al-Attas [14], the eminent Muslim educator, spoke of the risk faced by Muslim education in its interface with Western education, he identified two features that concerned him beyond all others. First was the way the relationship between teacher and student was conceived. Second was the imbalance between cognitive and other developmental measures, especially those concerning moral and spiritual development. He suggested that Western educational assumptions are too often built around more transactional notions of teacher-student relations and more pragmatic, outcomes-based aims rather than those pertaining to holistic human achievement and wellbeing. I believe any of the research perspectives noted above would attest to al-Attas's perceptions about what amounts to an unhelpful and arguably uninformed instrumentalism in Western education. Moreover, such concerns about Western education generally must have ramifications that a similar instrumentalism is likely to be found in Western teacher education.

3. Instrumentalism in Teacher Education

Ken Zeichner [15] identified three different philosophies of teacher education as they had functioned in the United States. They ranged from ones that supported extant notions of professionalism to those designed to challenge the status quo with the principal aim of instilling greater justice in schools and in the future lives of their students. Beyond the specifications he identified, the work was useful in illustrating that teacher education can and has been many different things, utilized at times for fundamentally divergent purposes, from those that are bound to the hegemonies of the day, what I refer to as instrumentalist in their essential purpose, to those that aim to disrupt in order to address inequities and improve the lives of education's clientele.

Paul Feyerabend [16] was critical of the ways in which education systems, including teacher education, had too often applied unimaginative instrumentalist assumptions to teaching. Ian Kidd (43) places Feyerabend in the same category as Michael Oakeshott and Martin Heidegger in seeing holistic learning being in place when education is conceived in terms of "releasement". By this term, he suggests '. . . that the purpose of education (is) not to induct students into prevailing norms and convictions, but rather to initiate them into the civilized inheritance of mankind (sic) [17] (p. 407).' The conception speaks to Enlightenment values, including around human rights, life and liberty, freedom of thought and speech, social justice and equity, in a word, to personal and communal wellbeing. Feyerabend's critique was not merely that instrumentalist assumptions resulted in poor educational practice but, moreover, that education was failing in its essential charter to advance the holistic wellbeing of the individual and address social ills in order to correct them. In this light, Zeichner's uncovering of divergent purposes of teacher education is more than merely of academic concern. It signals a struggle for the soul of teacher education.

One can see similar divergences of purpose in Australian teacher education over time. In some of its earliest manifestations in the colonial era, forms of teacher education, bare as they were, could be seen to be disruptive of the hegemonies that kept the poorer, largely convict-related classes uneducated and powerless, aiming to initiate what Kidd refers to as the "civilized inheritance of mankind". It was a teacher education, mounted onto an educational innovation, designed to make a difference, to improve the lives of individuals and bring effect to a more just and equitable society than was the extant. In the mid-nineteenth century, this applied especially to forms of Catholic teaching and teacher education in the hands of religious orders like the Sisters of St Joseph, a homegrown order of nuns trained to educate the poorer sections of society in order to improve their status and competitiveness [18–20]. In the secular sphere, the advent of trained female career teachers in the nineteenth century was itself

disruptive of the status quo in its day [21] as, in a sense was the establishment of "free, compulsory and secular education" for the entire population in the later part of the century.

Many of the various parliamentary Acts that established these regimes of "public education" can be seen to be replete with holistic personal and social agendas quite beyond instrumentalist ones concerned with basic literacy and numeracy. As an example, the New South Wales Public Education Act of 1880 [22] identified a range of educational goals suitable to the citizenry of the new nation being planned for the twentieth century. Among the goals were ones that saw all students, regardless of their heritage, being inculcated into full citizenry, including understanding the history and values that underpinned their society's norms, legal codes and social ethics. In a word, the knowledge and values that the old order would have seen as residing properly and exclusively in the ruling classes were to be shared with the entire population, including the descendants of the convict class and Indigenous peoples. As if to reinforce the disruption to the old, colonial order, teachers' colleges were set up in the early years of the twentieth century to ensure this new public education would be staffed by trained teachers with a charter to educate all sectors of society, including the poorest and those most alienated.

Nonetheless, for all of this heritage, teacher education in Australia has too often been characterized by instrumentalist aims and purposes, tending towards reactivity, rather than proactivity [23]. That is another way of saying it has tended too often to be a conservative industry, given to serving the needs of schools and their systems as they stand, rather than being in any way disruptive of their priorities and government-driven policies. As such, teacher education has become largely a service industry, serving teacher employment bureaucracies and the government hegemonies behind them, rather than being driven primarily by the social and emotional needs of students and the betterment of society, in the way of its heritage. Moreover, teacher education as a service industry can then be distracted from seeing and being guided by the latest research in what would seem to be its core business, namely, the optimization of learning.

4. Holistic Learning Factors: The Research That Should Be Driving Teacher Education

As indicated above, the notion of holism in education can be traced back to the Persians, Arabs and Greeks of ancient times, as well as the key scholars of Islam's Golden Age [24]. The concept and reality can also be found in the works of key twentieth century educators, such as John Dewey [25–27], Maria Montessori [28], Loris Malaguzzi [29] and Vasily Sukhomlinksy [30], if not always using the language of holism. Late in the century and into the twenty-first century, the language of holism became more common. In recent times, the language has been found explicitly in a number of works. A name often associated with it is William Doll [31], a Habermasian scholar who warned that the ideas dominating in "modern" education were inadequate to the needs of the current world. They were built too much around old scientific paradigms of empirical certainties and cognition as separable from the rest of the person. We needed instead a "postmodern" paradigm built around new scientific conceptions of uncertainty and complexity, including of our understanding of cognition [10,11]. In other words, we needed to see the person and education of the person as a holistic enterprise. We find similar thinking in the works of David Marshak [32], who spoke of the organistic wholeness of the person, and John Miller [33] who coined the phrase "holistic curriculum" to capture the kind of teaching/learning needed to cater for the whole person.

Into this mix, and relying in part on the new thinking, came the report of the Carnegie Corporation's 1994 Task Force on Learning. The report [34] served as a correction against an era wherein instrumentalist thinking and objectives had dominated teaching and teacher education in most Western domains [35,36]. Apart from prominent works around holism, especially in the curriculum, it reflected, and in some ways anticipated, emerging neuroscientific evidence that made revisioning of the understanding of cognition ever more compelling. For example, research insights from the works of Daniel Goleman [37], Robert Sternberg [38], Antonio Damasio [39], Howard Gardner [40] and Mary Immordino-Yang [12], among others, determined that cognition is inseparable from other developmental factors, including emotionality, sociality and morality.

Hence, a feature of the Carnegie Report was in its broadening those instrumentalist conceptions of cognition that had driven the art of teaching and teacher education down to what Lawrence Stenhouse [41] would refer to as "training and instruction" and Jurgen Habermas [3,4] would count as "empirical-analytic" ways of knowing, ones impelled by the cognitive interest in control, rather than knowing in the fullest sense. In both cases, these scholars were referring to low level cognition and associated practice, a cognition that Immordino-Yang and Damasio [42] would describe as '. . . disembodied systems, somehow influenced by but detached from emotion and the body [42] (p. 3).' Stenhouse's holistic learning conception involved "initiation" into a field of knowledge whereby the student, including the student teacher, would become effectively an artisan in that particular field:

> . . . by virtue of their meaningfulness, curricula are not simply instructional means to improve teaching but are expressions of ideas to improve teachers. [41] (p. 68)

In other words, initiation in teacher education would see the future history teacher *become* a historian, the future science teacher a scientist, the future music teacher a musician, and so on. The fullness of knowing is in becoming and, in that respect, being initiated into "the civilized inheritance of mankind". The fullness of knowing is, in Habermas's words, a *praxis*, an action that effects change.

In justifying knowing as *praxis*, Habermas [3,4] broadened the knowing impelled by the cognitive interest in control to two further ways of knowing, referred to as "historical-hermeneutic" and "critical/self-reflective". The former is driven by the cognitive interest in understanding meanings while the latter is impelled by the cognitive interest in emancipation. Emancipation connotes a desire to be a free agent of knowing while critical/self-reflective knowing, the epistemic result of the cognitive interest, denotes agency itself, being in command of one's knowing, a conception not dissimilar to Stenhouse's idea of initiation. For Habermas, this way of knowing provides for the only truly authentic human knowing, a profoundly moral knowing driving fearlessly beyond the politically correct, or safe knowing. Unlike empirical-analytic knowing, this is a knowing that requires human encounter and ultimately self-knowing. It also requires much in the way of imagination, including moral imagination and the attached emotional capacity. In his critique of the Enlightenment project, Habermas [5] suggests it has robbed us of '. . . the spontaneous powers of imagination, of self-experience and of emotionality [5] (p. 13).'

In many ways, Elliot Eisner grounded Habermas's epistemology in the practice of teaching and teacher education. In his work titled, *The Educational Imagination* [43], he reacted to instrumentalist "reforms" that had robbed education of imagination. His interest was in restoring a sense of imagination to the ways in which curriculum is designed and effected. Eisner, an art educator, extrapolated from the knowing proper to art to make the point that feeling (emotion) and experience are entailed in knowing of any kind. In later work, Eisner [44] critiqued those dominant conceptions of cognition that focus overly on knowing devoid of feeling, a knowing that is all about verbal constructs, what he referred to as "discursive reductionism", a secondary rather than primary form of knowing where knowing is assumed to be a product of discourse. For Eisner, it is the most reduced by-product of a narrow cognition that we fail to grasp the obvious truth that knowing precedes as often as follows from, and is always a little more than, the words that contain it. Eisner captures well the inherent limitations of instrumentalism and the damages it can do to learning.

For Eisner, this by-product afflicts both educational research and classroom practice. In terms of research, the affliction of discursive reductionism renders most projects as little more than technical exercises, producing volumes of fairly meaningless data, whereas his own methodology is termed "educational connoisseurship and criticism" [45]. Connoisseurship '. . . represents an effort to understand the meaning and significance that various forms of action have for those in a social setting [45] (p. 146).' In terms of classroom practice, discursive reductionist instrumentalism limits curricula and their assessment to what is most easily known and testable, most likely ethnocentric, intolerant of difference and so prolonging injustice. In contrast, connoisseurship renders '. . . a

heightened awareness of the qualities of life so that teachers and students can become more intelligent [46] (p. 142).' Mary Elizabeth Moore [47] proffers:

> Eisner has offered a persistent critique of the over-dependence of education on science, modern technology and narrowly defined learning processes and content. He has spoken to the importance of artistry in teaching and the importance of educational imagination throughout the entire system of schooling. [47] (p. 138)

> Similarly to Stenhouse's sense of initiation and Habermas's critical/self-reflective knowing, connoisseurship connotes the art of appreciation, the knowing that sees rather than merely looks, a knowing that draws on our values and commitments as much as our observations and descriptions. Eisner [44] speaks of the need for the learner to be immersed in the *experience* of knowing. This experience is ' ... derived from the material the senses provide ... and refining ... the senses [as] a primary means for expanding ... consciousness'. [44] (pp. 28–29)

An important allied contribution to breaking out of the instrumentalist bind and to the wider goals of learning is made by Max van Manen's notions of "phenomenological pedagogy" [48] and "pedagogical thoughtfulness" and "pedagogical tact" [49]. Van Manen's reputation is for being one of Habermas's key interpreters, especially in making application of his epistemology to education. These pedagogical concepts serve to address the deficits of instrumentalist-bound education and to advance the goals entailed in achieving holistic learning. By these understandings, pedagogy must be sensitive to the lived experience of students, focused on interpreting this experience and so deepening student learning, including about themselves.

Drawing on this array of educationally innovative conceptions, the Carnegie Report [34] defined the range of learning skills necessary to the fullness of learning and, by dint of implication, to be properly incorporated in the training of teachers. It spoke of learning concerned with communicative and empathic capacity, reflectivity and self-management, emphasizing that effective learning unleashes within the learner the cognitive, affective and moral energies that engage, empower and effect deep learning, learning that goes far beyond that which can be achieved when instrumentalist aims and purposes are determining educational directions. Indeed, it was the narrow instrumentalist approach to teaching and teacher education that was blamed for students' failure to achieve in spite of the vast resources that had been poured into teaching and teacher education in the USA.

In the spirit of the Carnegie Report, Fred Newmann and associates identified a range of teacher-related practices that research showed to be linked with holistic learning. The work centered on identifying the pedagogical dynamics required for what was termed "authentic pedagogy" [1]. Beyond some of the more instrumentalist practices, such as sound techniques, was one associated with the importance of the respectful relationship between teacher and student that ensures students feel accepted, understood and valued. Moreover, the ultimate pedagogical dynamic, a kind of *sine qua non* for holistic learning, was referred to as the "trustful, supportive ambience". These are practices that echo the perspectives of John Dewey [50], Richard Peters [51] and David Carr [52], to name a few, that education is inherently a moral enterprise, that all education is moral education, in that sense. In Peters' words, it is education where the "knowledge condition" and the "values condition" are in alliance. Such an alliance is deemed essential to achieving holistic learning.

In a similar way, Matthew Davidson, Vladimir Khmelkov and Thomas Lickona [53] speak of "moral character" and "performance character" being essential allies in the business of holistic learning. Their approach 'seeks to maximize the power of moral and performance character by viewing character as needed for, and potentially developed from, every act of teaching and learning [53] (p. 428).' Meanwhile, Karen Osterman's [54] work refers to a cognition/affect/sociality nexus that enhances learning through environments where students feel they belong and experience a sense of emotional wellbeing. The nexus rests on teacher practice that emphasizes a balance between the teacher-student relationship and sound pedagogy. The teacher who has perfected this balance is the one most likely to optimize student learning. The teacher who has not perfected it will continue to oversee failure, both in

terms of student wellbeing and achievement. Jacques Benninga [55] provided empirical evidence of the effectiveness of the nexus in his work where enhanced performance in Californian basic skills test results was linked with the implementation of a moral development program. In a word, there is no achievement, no holistic learning, without the assurance of wellbeing. This is precisely the point at which instrumentalism and a values pedagogy collide.

5. The Collision of Instrumentalism and Values Pedagogy in Australia

Typical of most Western regimes, late twentieth century education in Australia was dominated by notions of instrumentalist competencies and outcomes [56]. These were largely premised on the need for schools to prepare young people for work and careers as their principal if not essential role. It was the combined effects of the likes of the Carnegie Report, along with the welter of research cited above, that led Australian authorities to pronounce a more holistic charter for Australian education in the form of *The Adelaide Declaration on National Goals for Schooling in the Twenty-first Century* [57]:

> Australia's future depends upon each citizen having the necessary knowledge, understanding, skills and values for a productive and rewarding life in an educated, just and open society . . . Schooling provides a foundation for young Australians' intellectual, physical, social, moral, spiritual and aesthetic development. [57] (p. 1)

Attempts to walk back some of the holism and social betterment goals in such an educational charter, including for reasons related to new threats to global security occasioned by terrorist episodes in New York, Washington, Bali and Madrid, were resisted when the same body met a decade later and reinforced the holism of the declaration [58]:

> Schools play a vital role in promoting the intellectual, physical, social, emotional, moral, spiritual and aesthetic development and wellbeing of young Australians. [58] (p. 4)

> The curriculum will enable students to . . . open up new ways of thinking. [58] (p. 13)

An immediate product of this newfound holism took the form of the Australian Values Education Program [2003–2010]. The Program began with a pilot study in 2003 [59], followed by the development of a *National Framework for Values Education* in 2005 [60]. A range of attached research and practice projects took place from 2005 to 2010, the most crucial of which were the two stages of the *Values Education Good Practice Schools Project* (VEGPSP) [61,62] and the *Project to Test and Measure the Impact of Values Education on Student Effects and School Ambience* [63,64]. The National Framework cited the Adelaide Declaration [57] as underpinning the spirit and intentions of the program and also made the direct link between good practice pedagogy and the instilling of a safe, supportive environment for learning. In other words, again, the inescapable connection between wellbeing and achievement, between the knowledge condition and the values condition [51], between performance character and moral character [53], between cognition, affect and sociality [54] was reinforced. By such an understanding, holistic learning and values are seen not to be in opposition nor in any way options in the business of learning. They are two sides of the same coin, a veritable "double helix" [65].

VEGPSP [61,62] involved three hundred and sixteen schools from all sectors, constituting approximately 100,000 students, 5000 teachers and fifty university researchers. Fifty-one clusters, formed from these schools, collaborated in constructing an intervention focused on the Framework's core values statement. Each project was supported by a university researcher who oversaw the project and assisted in writing the cluster report. Many of the reports spoke of the enhanced calmness and improved behavior of and communication among students and between students and teachers. Reports spoke of the greater sense of reflectivity on the part of students, of their enhanced resilience and more apparent social skills, of improved relationships of care and trust between students and students and teachers, and of all of this resulting in demonstrated levels of enhanced academic diligence. The positive effects were shown across the range of educational goals, including emotional, social,

moral and spiritual ones, and furthermore how these impacted on academic diligence. The cognition required for academic achievement was shown to be inseparable from holistic development. Hence, the connection between values education and good practice pedagogy was demonstrated with sufficient clarity to impel the new language of "values pedagogy" being coined [23]. In a word, findings confirmed the double helix between values pedagogy and holistic learning, as evidenced by university researcher reports from each of the two stages of VEGPSP:

> ... by creating an environment where (the) values were constantly shaping classroom activity, teachers and students were happier, and school was calmer ... student learning was improving. [62] (p. 120)

> Starting from the premise that schooling educates for the whole child and must necessarily engage a student's heart, mind and actions, effective values education empowers student decision making ... students can be seen to move in stages from growing in knowledge and understanding ... to an increasing clarity and commitment ... and then concerted action in living those values in their personal and community lives. [61] (p.11)

The link between an explicit values pedagogy and holistic learning was further confirmed in the evaluation phase. The *Project to Test and Measure the Impact of Values Education on Student Effects and School Ambience* [64] was designed to test and measure all the reported claims being made in earlier phases, employing standard quantitative and qualitative instruments [63]. Claims that were verified by means of this extra layer of testing included the following:

> improved environment ... increase in school cohesion ... clearer sense of purpose ... the creation of a safer and more caring school community. [64] (pp. 10, 89, 106)

The Executive Summary of the study included statements that attempted to explain the reasons why values pedagogy is found to be synergistic with holistic learning:

> ... as schools give increasing curriculum and teaching emphasis to values education, students become more academically diligent, the school assumes a calmer, more peaceful ambience, better student-teacher relationships are forged, student and teacher wellbeing improves and parents are more engaged with the school. [64] (p. 12)

> Teachers perceived that explicitly teaching values and developing empathy in students resulted in more responsible, focused and cooperative classrooms and equipped students to strive for better learning and social outcomes. [64] (p. 14)

> Thus, there was substantial quantitative and qualitative evidence suggesting that there were observable and measurable improvements in students' academic diligence, including increased attentiveness, a greater capacity to work independently as well as more cooperatively, greater care and effort being invested in schoolwork and students assuming more responsibility for their own learning ... [64] (p. 6)

6. Ramifications for Teacher Education

In light of the above evidence concerning the effects of values pedagogy on holistic learning, one might ask why it is that teacher education has not shown more signs of adjusting to accommodate this kind of evidence. Answers to such a question are complex and one needs to be careful about generalizing around complex and variegated issues. Nonetheless, cautious generalization can be proffered.

For the most part, teacher education remains in our time a largely conservative, essentially service industry, known more for its reactivity than proactivity. Teacher education tends to remain firmly in the hands of government, with ministries of education controlling the criteria to be applied to what is deemed acceptable in teacher education programs, often applying a form of registration as a means of surveillance of the industry:

> The NSW Education Standards Authority (NESA) works closely with tertiary institutions to assess teacher education courses. [66]

In such a circumstance, compliance to rather than disruption of government priorities and policies will be, in large measure, the order of the day. Unless an education minister or someone in their bureaucracy happens to have an eye for what is going on in holistic learning research, the tendency will be for the status quo to be maintained and sometimes for teacher education to become somewhat of a political tool, especially around election time. In this situation, the shape and form of teacher education will be determined by its sponsors and funders in government. The likelihood that these sponsors and funders will be responsive to the latest research, or even aware of it, is limited, to say the least. The chances for any individual teacher educator or group thereof to make changes to the teacher education curriculum, albeit guided by the weightiest of research, will be even more limited in such circumstances.

Second, teacher education, along with teaching as a profession, tends to be heavily unionized. Arguably, this is another layer of corporate life and bureaucracy whose prime task is to safeguard the rights of its members. For example, in its ethics statement, the New South Wales Teachers Federation has the following as its first four key principles:

1. Teachers and other educational personnel employed in any area of public education should be members of the New South Wales Teachers Federation and uphold Federation's policy.
2. Members should aim to improve the working conditions of all Federation members.
3. Members should be loyal to colleagues at all times and refrain from adversely criticising them in the hearing of the public or students.
4. Members should not take part in any undesirable competitions or activities which pit member against member and one school or educational institution against another in unhealthy rivalry. [67]

While such bodies might take up wellbeing and social issues as part of their charter, control and protection of the profession is invariably their first and overarching concern. Least of all is it characteristic of such bodies to be overly concerned with the latest research findings and insights about learning.

Third, teaching and teacher education are largely corporate entities, rather than being highly individualized, and this is seen in the way both employer and union bodies refer to them, as above. That is, teacher educators, like teachers themselves, work essentially as teams in large institutions, rather than on their own in private practice. As a result, surveillance and the need to conform to corporate requirements is arguably heightened when compared with other professions, such as medicine and law. These are all limitations on the power of individual teacher educators to disrupt the established order regardless of the injustice entailed in it or the weight of research evidence that rails against it.

The other factor that might explain teacher education's relative acquiescence to the established order is that its research base has been so largely dependent on research derived from its so-called foundational disciplines, especially psychology and sociology, rather than overwhelmingly classroom learning related research. As a result, teacher education has often been dependent on what we might refer to as borrowed findings, suitable perhaps to the foundational discipline *per se* but not always attuned to the realities of what is required in the actual learning site. There are exceptions to this phenomenon [68–70] but recourse to the foundational research remains strong in the literature that underpins much of teacher education as well as providing supposedly updated advice for practicing teachers [71–75]. Instances of this phenomenon are seen especially in those paradigms of learning concerned with linear stage, moral and sociocultural theories [76–79]. In spite of serious counter-research by the likes of Gilligan [80], Hoffman [81] and Zahn-Waxler et al. [82], Freudian, Piagetian, Vygotskyan and Kohlbergian research has often presented as offering the most enlightened bases for the practical knowledge needed by the teacher.

Granted the above, a further problem for teacher education could be that the basis of its "foundations" has rested for too long on theories and research that relied on the kinds of cognition theories that neuroscience, epistemology and philosophy, as explicated above, have been challenging for some time. Moreover, challenges wrought by the kinds of practical classroom-based findings identified for values pedagogy have been slow to be incorporated into teacher education. The result is that instrumentalist thinking continues to dominate and the latest insights into holistic learning often carry less weight than should be the case.

7. Conclusions

The article has focused on updated research on factors related to holistic learning, exploring especially research insights gleaned from values pedagogy and associated research. The article has juxtaposed those insights with the instrumentalism that has tended too often to dictate teacher education directions. It is argued that this instrumentalism derives from a range of factors concerned with teacher education's encasement in government-driven priorities and policies as well as its heavy reliance on research derived from its foundational disciplines, rather than from research emanating from live learning sites. This situation leaves teacher education less potent than it should be in producing the kinds of teachers needed to fulfil the elevated charter for schooling to offer holistic development to each student as well as address and redress social issues of inequity and injustice.

It should be noted that the article proffers to identify some weaknesses that persist in teacher education fulfilling what should be its essential charter, namely, to prepare future teachers to ply their trade on the basis of the most updated and assured research about the contexts in which and the methods by which young people's learning is optimized. It is not intended to be critical of teacher educators themselves nor of any particular teacher education institute. Least of all is it intended to demean in any way the vitally important role that teachers and teacher educators play in the lives of their students. It is intended merely to press teacher education stakeholders, be they governments, unions, university heads, teacher education personnel, teachers or parents, to consider whether the thrust of teacher education is guided by the latest research into holistic learning for, according to the evidence, that is where its essential charter to advance individual wellbeing and social betterment will be realized.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Lovat, T. Values as the pedagogy: Countering instrumentalism. In *Pedagogy and Pedagogical Challenges*; Tirri, K., Ed.; IntechOpen: London, UK, 2020. Available online: https://www.intechopen.com/online-first/values-as-the-pedagogy-countering-instrumentalism (accessed on 17 October 2020).
2. Lovat, T.; Clement, N. Quality teaching and values education: Coalescing for effective learning. *J. Moral Educ.* **2008**, *37*, 1–16. [CrossRef]
3. Habermas, J. *Knowledge and Human Interests*; Shapiro, J., Translator; Heinemann: London, UK, 1972.
4. Habermas, J. *Theory and Practice*; Shapiro, J., Translator; Heinemann: London, UK, 1974.
5. Habermas, J. Modernity versus postmodernity. *New Ger. Crit.* **1981**, *22*, 3–14. [CrossRef]
6. Churchland, P. *Braintrust: What Neuroscience Tells Us about Morality*; Princeton University Press: Princeton, NJ, USA, 2012.
7. Narvaez, D. *Neurobiology and the Development of Human Morality: Evolution, Culture, and Wisdom*; W. W. Norton & Co.: New York, NY, USA, 2014.
8. Narvaez, D. *Embodied Morality: Protectionism, Engagement and Imagination*; Palgrave Macmillan: London, UK, 2016.
9. De Grasse Tyson, N. *Astrophysics for People in a Hurry*; W.W. Norton & Co.: New York, NY, USA, 2017.
10. Jorg, T.; Davis, B.; Nickmans, G. Towards a new, complexity science of learning and education. *Educ. Res. Rev.* **2007**, *2*, 145–156. [CrossRef]

11. Lovat, T. Towards a new complexity science of learning and education (Invited Response). *Educ. Res. Rev.* **2008**, *3*, 79–81.
12. Immordino-Yang, M.H. Implications of affective and social neuroscience for educational theory. *Educ. Philos. Theory* **2011**, *43*, 98–103. [CrossRef]
13. Clement, N.; Lovat, T. Neuroscience and education: Issues and challenges for curriculum. *Curric. Inq.* **2012**, *42*, 534–557. [CrossRef]
14. Al-Attas, S. *Aims and Objectives of Islamic Education*; Hodder & Stoughton: Jeddah, Saudi Arabia, 1979.
15. Zeichner, K. Different conceptions of teacher expertise and teacher education in the USA. *Educ. Res. Perspect.* **2006**, *33*, 60–79.
16. Feyerabend, P. *Against Method: Outline of an Anarchistic Theory of Knowledge*; Humanities Press: London, UK, 1975.
17. Kidd, I. Feyerabend on science and education. *J. Philos. Educ.* **2013**, *47*, 407–422. [CrossRef]
18. Foale, M. The Josephite Story: The Sisters of St Joseph, Their Foundation and Early History, 1866–1893. Unpublished Ph.D. Thesis, The University of Adelaide, Adelaide, SA, Australia, 1987.
19. Foale, M. *The Josephite Story: The Sisters of St Joseph, Their Foundation and Early History, 1866–1893*; St Joseph's Generalate: Sydney, NSW, Australia, 1989.
20. O'Farrell, P. *The Catholic Church in Australia: A Short History, 1788–1967*; Thomas Nelson: Melbourne, VIC, Australia, 1968.
21. Whitehead, K. *The New Women Teachers Come Along: Transforming Teaching in The Nineteenth Century*; Australian and New Zealand History of Education Society: Sydney, NSW, Australia, 2003.
22. NSW Department of Public Instruction. *Public Instruction Act of 1880 and Regulations*; William Applegate Gullick: Sydney, NSW, Australia, 1912.
23. Lovat, T.; Dally, K.; Clement, N.; Toomey, R. Values pedagogy and teacher education: Re-conceiving the foundations. *Aust. J. Teach. Educ.* **2011**, *36*, 30–44. [CrossRef]
24. Lovat, T. Islamic education today and yesterday: Principal themes and their potential to enlighten Western education. In *Global Perspectives on Teaching and Learning Paths in Islamic Education*; Huda, M., Safar, J., Mohamed, A., Jasmi, K., Basiron, B., Eds.; IGI Global: Hershey, PA, USA, 2019; pp. 1–20.
25. Dewey, J. *The Child and The Curriculum*; University of Chicago Press: Chicago, IL, USA, 1956.
26. Dewey, J. *Experience and Education*; Free Press: Washington, DC, USA, 1999.
27. Dewey, J. *Democracy and Education: An Introduction to the Philosophy of Education*; CreateSpace Independent Publishing Platform: New York, NY, USA, 2013.
28. Montessori, M. *The Montessori Method*; EarthAngel Books: Blacksburg, VA, USA, 2010.
29. Rinaldi, C. *Dialogue with Reggio Emilia: Listening, Researching and Learning*; Routledge: London, UK, 2006.
30. Sukhomlinsky, V. *My Heart I Give to Children*; EJR Language Service P/L: Graceville, QLD, Australia, 2016.
31. Doll, W. *A Post-Modern Perspective on Curriculum*; Teachers College Press: New York, NY, USA, 1993.
32. Marshak, D. *The Common Vision: Parenting and Educating for Wholeness*; Peter Lang Publishing: New York, NY, USA, 1997.
33. Miller, J. *The Holistic Curriculum*; OISE Press: Toronto, ON, Canada, 1996.
34. Carnegie. *Years of Promise: A Comprehensive Learning Strategy for America's Children*; Carnegie Corporation of New York: New York, NY, USA, 1996.
35. Bloom, B. (Ed.) *Taxonomy of Educational Objectives: Book 1 Cognitive Domain*; Longman: London, UK, 1956.
36. Tyler, R. *Basic Principles of Curriculum and Instruction*; University of Chicago Press: Chicago, IL, USA, 1949.
37. Goleman, D. *Emotional Intelligence: Why It Can Matter More Than IQ*; Bloomsbury: London, UK, 1996.
38. Sternberg, R. *The Nature of Cognition*; MIT Press: Boston, MA, USA, 1999.
39. Damasio, A. *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*; Heinemann: London, UK, 2003.
40. Gardner, H. *Frames of Mind: The Theory of Multiple Intelligences*; Basic Books: New York, NY, USA, 2011.
41. Stenhouse, L. *An Introduction to Curriculum Research and Development*; Pearson: London, UK, 1975.
42. Immordino-Yang, M.H.; Damasio, A.R. We feel, therefore we learn: The relevance of affect and social neuroscience to education. *Mind Brain Educ.* **2007**, *1*, 3–10. [CrossRef]
43. Eisner, E. *The Educational Imagination: On the Design and Evaluation of School Programs*; Macmillan: New York, NY, USA, 1979.
44. Eisner, E. *Cognition and Curriculum: A Basis for Deciding What to Teach*; Longman: New York, NY, USA, 1994.

45. Eisner, E. *Educational Connoisseurship and Criticism: The Form and Functions in Educational Evaluation*; Falmer Press: Philadelphia, PA, USA, 1976.
46. Eisner, E. *The Enlightened Eye: Qualitative Inquiry and the Enhancement of Educational Practice*; Merrill: Upper Saddle River, NJ, USA, 1998.
47. Moore, M. *Teaching from the Heart: Theology and Educational Method*; Trinity Press International: Harrisburg, PA, USA, 1991.
48. Van Manen, M. Phenomenological pedagogy. *Curric. Inq.* **1982**, *12*, 283–299. [CrossRef]
49. Van Manen, M. *The Tact of Teaching: The Meaning of Pedagogical Thoughtfulness*; State University of New York Press: Albany, NY, USA, 1991.
50. Dewey, J. *Moral Principles in Education*; Houghton Mifflin, Co.: Boston, MA, USA, 1909.
51. Peters, R.S. *Moral Development and Moral Education*; George Allen & Unwin: London, UK, 1981.
52. Carr, D. Personal and professional values in teaching. In *International Research Handbook on Values Education and Student Wellbeing*; Lovat, T., Toomey, R., Clement, N., Eds.; Springer: Dordrecht, The Netherlands, 2010; pp. 63–74.
53. Davidson, M.; Khmelkov, V.; Lickona, T. The power of character: Needed for, and developed from, teaching and learning. In *International Research Handbook on Values Education and Student Wellbeing*; Lovat, T., Toomey, R., Clement, N., Eds.; Springer: Dordrecht, The Netherlands, 2010; pp. 427–454.
54. Osterman, K. Teacher practice and students' sense of belonging. In *International Research Handbook on Values Education and Student Wellbeing*; Lovat, T., Toomey, R., Clement, N., Eds.; Springer: Dordrecht, The Netherlands, 2010; pp. 239–260.
55. Benninga, J.; Berkowitz, M.; Kuehn, P.; Smith, K. Character and academics: What good schools do. *Phi Delta Kappan* **2006**, *87*, 448–452. [CrossRef]
56. Mayer, E. Key Competencies. Report of the Committee to Advise the Australian Education Council and Ministers of Vocational Education, Employment and Training on Employment-Related Key Competencies for Post-Compulsory Education and Training (Mayer Report). Canberra, 1992. Available online: http://hdl.voced.edu.au/10707/72980 (accessed on 29 October 2020).
57. MCEETYA. *The Adelaide Declaration on National Goals for Schooling in the Twenty-First Century*; Ministerial Council on Education, Employment, Training and Youth Affairs: Canberra, NSW, Australia, 1999. Available online: https://catalogue.nla.gov.au/Record/3006287 (accessed on 28 October 2020).
58. MCEETYA. *Melbourne Declaration on Educational Goals for Young Australians*; Ministerial Council on Education, Employment, Training and Youth Affairs: Canberra, NSW, Australia, 2008. Available online: http://www.curriculum.edu.au/verve/_resources/National_Declaration_on_the_Educational_Goals_for_Young_Australians.pdf (accessed on 28 October 2020).
59. ADEST (Australia Department of Education Science and Training). *Values Education Study*; executive summary final report; Curriculum Corporation: Melbourne, VIC, Australia, 2003. Available online: http://www.curriculum.edu.au/verve/_resources/VES_Final_Report14Nov.pdf (accessed on 28 October 2020).
60. ADEST (Australia Department of Education Science and Training). *National Framework for Values Education in Australian Schools*; Australian Government Department of Education, Science and Training: Canberra, NSW, Australia, 2005. Available online: http://www.curriculum.edu.au/verve/_resources/Framework_PDF_version_for_the_web.pdf (accessed on 28 October 2020).
61. ADEEWR (Australia Department of Education, Employment and Workplace Relations). *At the Heart of What We Do: Values Education at the Centre of Schooling*; Report of the Values Education Good Practice Schools Project—Stage 2; Curriculum Corporation: Melbourne, VIC, Australia, 2008. Available online: http://www.curriculum.edu.au/values/val_vegps2_final_report,26142.html (accessed on 28 October 2020).
62. ADEST (Australia Department of Education Science and Training). *Implementing the National Framework for Values Education in Australian Schools: Report of the Values Education Good Practice Schools Project—Stage 1: Final Report*; Curriculum Corporation: Melbourne, VIC, Australia, 2006. Available online: http://www.curriculum.edu.au/verve/_resources/VEGPS1_FINAL_REPORT_081106.pdf (accessed on 28 October 2020).
63. Lovat, T.; Dally, K. Testing and measuring the impact of character education on the learning environment and its outcomes. *J. Character Educ.* **2018**, *14*, 1–22.
64. Lovat, T.; Toomey, R.; Dally, K.; Clement, N. *Project to Test and Measure the Impact of Values Education on Student Effects and School Ambience*; Report for the Australian Government Department of Education, Employment

and Workplace Relations (ADEEWR) by The University of Newcastle, Australia; DEEWR: Canberra, NSW, Australia, 2009. Available online: http://www.curriculum.edu.au/verve/_resources/Project_to_Test_and_Measure_the_Impact_of_Values_Education.pdf (accessed on 28 October 2020).
65. Lovat, T.; Toomey, R. (Eds.) *Values Education and Quality Teaching: The Double Helix Effect*; Springer: Dordrecht, The Netherlands, 2009.
66. Teach NSW. Teacher Education Courses. Advice to Prospective Teachers in New South Wales about Recognised Australian Teacher Education Institutions. 2020. Available online: https://teach.nsw.edu.au/becomeateacher/teacher-education-courses (accessed on 7 November 2020).
67. NSWTF. Ethics. Ethics Statement of New South Wales Teachers Federation. 2020. Available online: https://www.nswtf.org.au/about/ethic (accessed on 7 November 2020).
68. Bowe, J.M.; Gore, J.M. Reassembling teacher professional development: The case for Quality Teaching Rounds. *Teach. Teach. Theory Pract.* **2017**, *23*, 352–366. [CrossRef]
69. Gore, J.M.; Bowe, J.M. Interrupting attrition? Re-shaping the transition from preservice to inservice teaching through Quality Teaching Rounds. *Int. J. Educ. Res.* **2015**, *73*, 77–88. [CrossRef]
70. Gore, J.; Lloyd, A.; Smith, M.; Bowe, J.; Ellis, H.; Lubans, D. Effects of professional development on the quality of teaching: Results from a randomised controlled trial of Quality Teaching Rounds. *Teach. Teach. Educ.* **2017**, *68*, 99–113. [CrossRef]
71. Darling-Hammond, L.; Flook, L.; Cook-Harvey, C.; Barron, B.; Osher, D. Implications for educational practice of the science of learning and development. *Appl. Dev. Sci.* **2020**, *24*, 97–140. [CrossRef]
72. Fast, I.; Erard, R.; Fitzpatrick, C.; Thompson, A.; Young, L. (Eds.) *Event Theory: A Piaget-Freud Integration*; Routledge: New York, NY, USA, 2009.
73. Isaksson, A. Kohlberg's theory of moral development and its relevance to education. *Scand. J. Educ. Res.* **2006**, *23*, 47–63. [CrossRef]
74. Murphy, S. How to Apply Piaget's Theory in the Classroom. The Classroom. 2018. Available online: https://www.theclassroom.com/children-vs-adult-learning-6368845.html (accessed on 1 November 2020).
75. Wilber, J. How to Apply Kohlberg's Theory of Moral Development in the Classroom. Owlcation. 2019. Available online: https://owlcation.com/academia/How-to-Apply-Kohlbergs-Theory-of-Moral-Development-in-the-Classroom-as-a-Teacher (accessed on 1 November 2020).
76. Kohlberg, L.; Hersh, R. Moral development: A review of the theory. *Theory Pract.* **1977**, *16*, 53–59. [CrossRef]
77. Piaget, J.; Inhelder, B. *The Psychology of the Child*; Basic Books: New York, NY, USA, 2008.
78. Shabani, K. Application of Vygotsky's sociocultural approach for teachers' professional development. *Cogent Educ.* **2016**, *3*. [CrossRef]
79. Strachey, J. *An Outline of Psychoanalysis*; W. W. Norton & Co.: London, UK, 1989.
80. Gilligan, C. *In a Different Voice: Psychological Theory and Women's Development*; Harvard University Press: Cambridge, MA, USA, 1982.
81. Hoffman, M.L. *Empathy and Moral Development: Implications for Caring and Justice*; Cambridge University Press: Cambridge, UK, 2000.
82. Zahn-Waxler, C.; Radke-Yarrow, M.; King, R.A. Child rearing and children's prosocial initiations toward victims of distress. *Child Dev.* **1979**, *50*, 319–330. [CrossRef] [PubMed]

education sciences

MDPI

Article

The Challenge of Educating Purposeful Teachers in Finland

Elina Kuusisto [1,*] and Kirsi Tirri [2]

[1] Faculty of Education and Culture, Tampere University, 33100 Tampere, Finland
[2] Faculty of Educational Sciences, University of Helsinki, 00170 Helsinki, Finland; kirsi.tirri@helsinki.fi
* Correspondence: elina.kuusisto@tuni.fi

Abstract: This article discusses the challenges of educating teachers in Finland. As a goal in teacher education for the 21st century we propose the purposeful teacher, referring to a teacher who has a long-term moral commitment to serve students, the school community and society. Our data collected from student (N = 912) and practising (N = 77) teachers yielded information on the purposes they identified as important in their lives. The survey included quantitative instruments and open-ended questions. The teachers identified happiness, relationships, work and self-actualisation as the most important contents of their aspirations. All the content categories could be understood as potential purposes in that the benefit extended beyond the teachers themselves. However, almost half of the student teachers (46%) and over half of teachers (55%) revealed only self-orientation. Less than half of them (43%, 36%, respectively) showed a beyond-the-self orientation, which is indicative of a purposeful teacher. Among the practising teachers, teaching appeared to be mainly a mediating factor in realising their purposes or aspirations. These results have implications related to contemporary teacher education in Finland. Both pre- and in-service teachers need to know about purposeful teaching in order to find meaning in their work.

Keywords: purpose in life; purposeful teacher; teacher education; Finland

Citation: Kuusisto, E.; Tirri, K. The Challenge of Educating Purposeful Teachers in Finland. *Educ. Sci.* **2021**, *11*, 29. https://doi.org/10.3390/educsci11010029

Received: 18 December 2020
Accepted: 11 January 2021
Published: 14 January 2021

1. Introduction

The changing situation in teacher education and the new demands of the 21st century call for teachers who find both a personal and a societal purpose in teaching, and who can commit to the teaching profession in the long term [1]. We propose purposeful teaching as a goal in teacher education to meet the challenges of the 21st century. Finland needs teachers who are ethical professionals with the freedom and responsibility to teach in ways that build meaning and purpose for themselves and for their students. Our aim in this article is to find out what purposes Finnish preservice and in-service teachers identify as important in their lives and in their profession.

A major goal within research-based teacher education in Finland for the last thirty years has been to produce pedagogically thinking, academic and autonomous teachers [2]. The new demands of the twenty-first century and the decreasing number of aspiring teachers emphasise the need for meaningful teacher education that combines the personal and professional interests of the learners [3].

As a notion, the purposeful teacher for the twenty-first century builds on the concept of purpose in education. In their relatively novel operationalisation, Damon, Menon, and Bronk [4] define purpose as "a stable intention to accomplish something that is both meaningful to the self and of consequence beyond the self over time" (p. 212). This definition is rooted in Viktor Frankl's [5] notion concerning the role of meaning and purpose in individual well-being, resilience and agency: one can find meaning through purpose in situations in which even basic needs are not met. In other words, knowing one's goals and committing oneself to them constitutes a moral beacon or compass [6] that encourages one to overcome challenges and stress and to find hope and resilience for the future. Using Damon et al.'s [3] definition of purpose as a basis, Tirri [1] describes a

purposeful teacher as someone with a long-term moral commitment to teaching that is both meaningful personally, and benefits students, colleagues and society. These definitions of purpose and a purposeful teacher share three dimensions: (1) long-term engagement, (2) personal meaningfulness, and (3) contribution beyond-the-self. The beyond-the-self dimension highlights the noble and moral character of purpose [7]. Accordingly, neither an aspiration nor a teacher devoid of prosocial aims can be identified as purposeful.

According to Day [8], highly committed teachers are associated with quality, vocation, calling and moral purpose. He also argues that moral purpose defines the nature of professionalism in teaching, the implication being that teaching is not just a job [8]. It could therefore be considered a vocation requiring deep personal commitment, as well as a profession with clear ethical codes [9]. As Tirri [1] states: "purposeful teachers are those who can combine the vocational and professional aspects in their work" (p. 2). In other words, teachers need to internalise a purpose as a virtue if they are to serve others within their profession [10]. Virtue-based approaches to education may help teachers to experience teaching as a morally fulfilling experience and allow them to reflect their personal purposes in relation to work [11]. Moral purposes in this context include the projection of optimism for the present and the future, commitment, and resilience to teaching in demanding circumstances [1].

Earlier research conducted among Finnish teachers has shown that they cannot separate personal and professional aspects in their teaching [9]. Their own moral character influences how they interact with their pupils and find meaning in their work. Ethical codes for teachers provide a professional value basis and guidance on how to develop in their profession. The ethical code for teaching in Finland, established in 1998, defines dignity, truthfulness, fairness, responsibility and freedom as core values [12]. It also highlights commitment to students, colleagues and the school community, as well as the importance of maintaining one's own well-being. These commitments were further strengthened through the Comenius Oath for teachers introduced in 2017 [13]:

> "As a teacher I am engaged in educating the next generation, which is one of the most important human tasks. My aim in this will be to renew and pass on the existing reserve of human knowledge, culture and skills. I will make continuous efforts to maintain and develop my professional skills, committing myself to the common goals of my profession and to the support of my colleagues in their work. I will act in the best interests of the community at large and strive to strengthen the esteem in which the teaching profession is held".

New teachers taking this Oath demonstrate their commitment to the ethical values and practices of their profession, in a similar manner to medical doctors abiding by the code of medical ethics.

The Finnish teachers' ethical code and Comenius Oath reflect Oser's [14] professional ethos of teachers that requires devotion to responsibility for actualizing justice, care, and truthfulness in instruction and interaction. Differences in ethos relate to how these dimensions are combined in teachers' daily practices, and the kind of strategies that are adopted if these values cannot be realised simultaneously: this is a moral dilemma in teaching [14]. In the Finnish context, teaching is understood as a moral activity, and teachers see themselves as ethical professionals who are committed to acting in the best interests of their students [15]. However, this kind of ethos cannot be taken for granted. In terms of teacher education, therefore, there is a constant need to update curricula to meet challenges related to changing society and globalisation.

In our vision to educate purposeful teachers we join researchers e.g., [16,17] and institutes of higher education [18] with a growing interest in the well-being of students, manifested in their support of reflection on who they want to become as persons and what they think would be a meaningful professional life. In recent years, for example, top US universities such as Harvard, New York University, Stanford, and Yale have created courses and programmes that give students the opportunity to reflect on their values, goals, and commitments, thereby to cultivate and develop their beyond-the-self oriented purposes

(e.g., [18]; see also [6,19]). The present study explores the extent to which the goal of the purposeful teacher presented above is evident in empirical data gathered from Finnish student teachers and practising teachers. We sought answers to the following research questions:

1. What purposes do Finnish teachers find important in their lives?
2. How do Finnish teachers incorporate professional aspects into their life purposes?

2. Materials and Methods

2.1. Participants

This study consists of two sub-studies. The participants of the first one were Finnish student teachers from the University of Helsinki (N = 912, age M = 27.79, SD = 7.53, min 18, max 57; n_{female} = 728; 80%, n_{male} = 177; 19%, $n_{no\ gender\ information}$ = 7; 1%), who completed the survey at the beginning of "General didactics" course (n = 602; 66%) or at the beginning of their teaching practicum course (n = 310; 34%). The aims of the participants were to become: (1) Kindergarten teachers specialised in early-childhood education and care (n = 172; 19%); (2) class teachers at elementary school (grades 1–6; n = 141; 18%); and (3) subject teachers at lower- and upper-secondary schools (grades 7–9, I-III, n = 576; 63%). The Kindergarten and class teachers were majoring in educational sciences. The subject teachers were majoring in foreign languages (n = 115); maths and science (n = 100); Finnish language and literature (n = 96); religious education (n = 67); handicrafts and home economics (n = 56); adult education (n = 50); social sciences (n = 49); biology and geography (n = 38); and special education (n = 21); no answer (n = 6).

The participants of the second sub-study were practising teachers in a Finnish school for basic education (N = 77, age M = 42, SD = 11.13, min 24, max 68, n_{female} = 63; 82%, n_{male} = 14; 18%) in Helsinki. They included class teachers (grades 1–6; n = 27; 35%) and subject teachers (grades 7–9; n = 35; 47%). Thirteen (18%) of them taught special-education classes or provided such services. One did not specify the field. The class teachers had majored in educational sciences. The subject teachers had majored in foreign languages (n = 9); maths and science (n = 7); Finnish language and literature (n = 6); handicrafts and home economics (n = 5); social sciences (n = 2); biology and geography (n = 2); physical education (n = 2); music education (n = 2).

2.2. Procedure and Instruments

In the first sub-study the student teachers answered an online version of the Youth Purpose Around the World survey [20], of which two measures were used in the present study. The authors of this paper, who are native speakers of Finnish, translated the measures from English into Finnish, and the questions were back-translated into English to confirm the accurate conveyance of the meaning.

Contents of purpose among the student teachers were assessed on a 20-item version of Roberts and Robins's [21,22] Life Goals Questionnaire, which has seven content areas: relationship-related (α = 0.609, 3 items), hedonistic (α = 0.721, 3 items), social (α = 0.625, 2 items), economic (α = 0.721, 4 items), religious (α = 0.870, 2 items), political (α = 0.589, 2 items), and aesthetic (α = 0.696, 4 items). The items were rated on a five-point Likert scale in response to the question: "How important are the following goals in your life?" (1 = not important to me, 5 = very important to me). For example, the relationship goal was measured as follows: "having good relationships with my family members", "having children", and "having a satisfying marriage/relationship." The hedonistic goal items were: "having new and different experiences", "having an exciting lifestyle", and "having fun", and the social goals: "volunteering in the community" and "helping others in need". The fact that the political dimension contained only two items could explain the below 0.60 alpha value that indicates low internal consistency.

The respondents were also asked an open-ended question: "What is your purpose in life?" [23], the aim being to see how well Roberts and Robins's [21] questionnaire captures

future teachers' aspirations and to find out how these student teachers incorporated professional aspects into their life purposes.

In the second sub-study, practising teachers answered the same open-ended question as the student teachers, as well as an explicit question designed for the study about how their purpose related to their profession: "How is teaching related to your purpose in life"?

2.3. Analyses

The scales of Roberts and Robins's [21] Life Goals Questionnaire were tallied, and the means, standard deviations and correlations were calculated. Spearman's nonparametric correlations were also computed in relation to the background variables (gender, age and education). IBM SPSS Statistics was utilised in these analyses. Further, following the analysis of the qualitative data, the results were quantified, cross-tabulated and subjected to Pearson's chi-square test, with the same background variables as mentioned above. The simultaneous assessment of the quantitative and qualitative results facilitated triangulation of the datasets, which were mixed and brought together to complement each other and thereby build a more valid and holistic picture of the topic in question [24].

A qualitative content analysis [25] of the written descriptions was conducted on two levels. The unit of analysis on the first level comprised words, phrases or sentences that communicated one specific content category. Roberts and Robins's [21] seven categories mentioned above were utilised as a deductive framework, and there were four additional categories (happiness, self-actualisation, work, and health) identified in previous studies on Finnish students of social services [26] and theology [27]. A total of 2095 content categories were identified from the descriptions given by the student teachers (N = 912), indicating 2.3 per respondent; the corresponding figures among the practising teachers (N = 77) were 122 in total and 1.6 per respondent. Below we present typical responses with symbols referring to the units of analysis:

> **"Happiness"** (Student teacher 1007).
>
> "*Family*, ***good standard of living***, nice job, **feeling good and happiness**" (Student teacher 4764).
>
> "**To be present for myself and other people** and ***make the world a better place for every one of us. Distribute humanity, understanding and friendship***, *experience and make memories*." (Student teacher 1001).
>
> (Symbol = Content category: **Bolding** = Happiness, *Italics* = Relationships, Underlining = Work, ***Bolding and Italics*** = Social, **Bolding and underlining** = Economics, *Italics and underlining*: hedonism).

These examples show the relatively condensed nature of the participants' responses, which was also the case with the practising teachers' statements. Therefore, all individual words were considered in the analysis.

Second, we analysed the self- and beyond-the-self (BTS) -orientations in the content categories. For example, the sentence, "to live a happy life and to make others happy, too" implies an association between happiness and both self- and BTS-orientation. Thus, the second unit of analysis was the beneficiary of the aspiration, whether it was the teachers themselves or/and others. The coding was entered into an Excel table in which each content category covered two columns, one for self- and one for BTS-orientation. If the teacher did not explicitly mention any beneficiaries, self-focus was assumed.

The practising teachers' answers to the question "How is teaching related to your purpose in life?" comprised descriptions defining associations between teaching and purpose. They were coded into three categories: self, other, and self-and-other, utilising the same protocol as described above.

To check reliability, both authors coded 10 per cent of the data. Cohen's kappa values [28] were calculated to evaluate interrater reliability: for example, the kappa values for happiness-self and happiness-other were 0.750 and 0.671, respectively. The kappa values of 18 categories ranged between 0.542–1.000 (M = 0.768, SD = 0.144). Four categories

(politics-self, hedonistic-other, health-other, aesthetic-other) occurred rarely in both the co-coded and the whole data. Thus, even one discrepancy could lower the kappa-value to an unacceptable level (−0.012–0.000). Disagreements were discussed and adjustments to the code book were made accordingly. The first author then conducted the analysis of the remaining data sets.

3. Results

3.1. Contents of Purposes Among Finnish Student Teachers and Practising Teachers

According to the means of the seven dimensions of Roberts and Robins' [21] scale the most important content categories of the student teachers were relationship-related, hedonistic, social and economic (Table 1). Religion, aesthetics, and political influence were rated the lowest. The majority of the variables correlated statistically significantly with each other (Table 1).

Table 1. The contents of the Finnish student teachers' aspirations as measured on Roberts and Robins' (2000) scale.

	Student Teachers *N* = 912		**Non-Parametrical Correlations**					
Categories of Roberts and Robins's scale	*N*	M (SD)	*1*	*2*	*3*	*4*	*5*	*6*
Relationships	907	4.29(0.78)	-					
Hedonism	909	3.73(0.80)	0.133 **	-				
Social	911	3.23 (0.89)	0.140 **	0.231 **	-			
Economic	911	2.72(0.75)	0.277 **	0.359 **	0.065 *	-		
Religion	910	2.02(1.25)	0.138 **	0.012	0.289 **	0.022	-	
Aesthetics	910	1.78(0.77)	−0.051	0.192 **	0.238 **	0.211 **	0.190 **	-
Political influence	910	1.61(0.73)	0.062	0.258 **	0.233 **	0.453 **	0.105 **	0.259 **

** $p < 0.01$, * $p < 0.05$.

Table 2 reports the content analysis of the written responses and shows how Robert and Robins's categories did not capture some of the most frequently mentioned contents, including happiness, work, and self-actualisation as well as less frequently declared health. However, the others were in practically the same order as reported above.

Table 2. The contents of the Finnish students' and practising teachers' aspirations according to the written statements.

	Student Teachers *N* = 912						**Practising Teachers *N* = 77**					
Categories in the written statements	*N*	%	Self *n*	%	Other *n*	%	*N*	%	Self *n*	%	Other *n*	%
Happiness	568	62	520	57	182	20	55	71	52	68	20	26
Relationships	402	44	318	35	133	15	10	13	5	6	5	6
Work	311	34	274	30	69	8	11	14	8	10	3	4
Self-actualization	245	27	240	26	23	3	21	27	21	27		
Hedonism	158	17	158	17	3	0	11	14	11	14		
Social	112	12	26	3	96	11	3	4			3	4
Political influence	105	12	19	2	94	10	5	6	1	1	4	5
Economic	70	8	69	8	5	1	1	1	1	1		
Religion	51	6	37	4	24	3						
Health	44	5	43	5	5	1	4	5	4	5		
Aesthetics	29	3	24	3	8	1	1	1	1	1		

The numbers related to the written responses refer to the number of participants. *N* means how many participants mentioned this particular content, and *n* refers to how many participants expressed the content benefitting oneself or others. The content categories in italics were created inductively by Manninen, Kuusisto, and Tirri [26] and Tirri and Kuusisto [27].

The main content category for over half of the student (n = 568, 62%) and practising (n = 55, 71%) teachers was happiness (Table 2). The participants referred explicitly to happiness, becoming happy or having a good life, a balanced life, being a good person and being loved. Happiness was generally self-oriented, but it was also wished for others including people who were close, or generally everyone. Participants did not wish to pursue happiness at the expense of others, aspiring instead to achieve it "while respecting all people and nature" (Student teacher 1208) or "while causing as little damage as possible to the rest of the world" (Student teacher 1265). Some of them expressed happiness as their ultimate goal, which they were realising via other and more concrete goals such as having a family, doing meaningful work, self-development, living in accordance with their values, helping others, making the world a better place, having enough income, serving God, maintaining health or doing art. In some cases, happiness was a prerequisite for a higher-level aspiration such as working as a teacher or being a parent, for example one participant mentioned: " . . . When I am happy I am a better mom." (Student teacher 2271).

Almost half (n = 402, 44%) of the student teachers placed relationships at the core of their aspirations. They wanted to have their own family, spouse, and children, to become a good mother or father, and to have close friendships. An older student pointed out that because she no longer had a family, her friends had become even more important in her life. In addition to mentioning relationships bringing meaning to themselves, the participants expressed a BTS-orientation in how they would take care of their family and raise their children "to become good people who can take others into account" (Student teacher 1331), considering it important to "create as good a basis for life as possible for their children" (Student teacher 1172). Parenthood had even changed their life purpose, as one student wrote: "Becoming a mother deepened my purpose. My task as a mother is to help my child to find a good life." (Student teacher 2271).

Twenty-seven per cent ($n_{\text{student teachers}}$ = 245, $n_{\text{practising teachers}}$ = 21) of the teachers rated self-actualisation among the most important content category. They wanted to learn new things and to focus on self-development, in line with the notion of lifelong learning and the ethical code of Finnish teachers [12,13]. Even though self-actualisation naturally relates to the self, the teachers wished to share their learning and to give the same opportunities to others: "I want be an example, showing how people can live their lives as they wish, in freedom, joy and love" (Student teacher 1053); "My purpose is to be my authentic self and also to help other people to be what they truly are." (Student teacher 1378).

Even hedonistic life goals were considered potential purposes: not only did the teachers want to enjoy life themselves, they also wished to help others to do so, to have new experiences, and to travel.

Among the Finnish teachers, social goals (included helping) ($n_{\text{student teachers}}$ = 112, 12%, $n_{\text{practising teachers}}$ = 3, 4%) and having political influence ($n_{\text{student teachers}}$ = 105, 12%, $n_{\text{practising teachers}}$ = 5, 6%) were more often oriented beyond-the-self than towards self (Table 2). The student teachers in particular wanted to help the weak and to engage in voluntary work for children, youth, animals and nature. Some of them felt passionately that they were put on earth to help children in need: "My existence is about helping abused children" (Student teacher 4376). Political influence was related to helping and influencing on the societal and global levels. The participants were determined to "make the world a better place" (Student teacher 4162) and "to live so that forthcoming generations could live in a safe (economically stable, free of conflict) and diverse (plentiful natural resources, stable climate, clean nature) (world)" (Student teacher 2117). Helping others and having political influence were also seen as benefitting oneself: "(my purpose is) to help others and through that to help myself" (Student teacher 1122).

Contents related to economic matters, religion, health, and aesthetics were rated the low both on Roberts and Robins's scale and in the written responses (Tables 1 and 2). Orientation to financial wealth among the teachers was relatively modest. They aimed to be economically independent and to be able to support themselves and their future family, and to support those in financial need: "I also want to be independent financially.

To help those closest to me, and other people, also financially" (Student teacher 1079). Even though religion and spirituality were on a general level mentioned seldom, these matters were highly important for some individuals, even providing a framework and a basis for their whole life [27,29]. This was also evident in Roberts and Robins's scale, in the largest standard deviation within religion category (*SD* = 1.24).

A few teachers ($n_{\text{student teachers}} = 44$, $n_{\text{practising teachers}} = 4$) mentioned having a long and healthy life or being creative in music and writing ($n_{\text{student teachers}} = 29$, $n_{\text{practising teachers}} = 1$), such as: "To become a musician" (Student teacher 1371); "To be a published author" (Student teacher 4598).

Sixty (7%) of the student teachers and one practising teacher were still unclear about their purpose, or they were searching for one. Some students ($n = 37$; 4%) claimed not to have a purpose and did not see the relevance of this type of reflection: "life does not have a purpose" (Student teacher 1050); "you cannot define one clear purpose. It is vain and not relevant. You just need to live" (Student teacher 1166); "I do not commit nor want to commit (to any purposes) because I really do not want anything so desperately. Goals and aims I do have, like becoming a teacher" (Student teacher 1076).

Table 3 shows the associations between the quantitative and qualitative data and the background variables. Among the student teachers, six of the content categories were statistically significantly more important for females than for males. However, of these, the *relationships* category was the only one in which gender difference was detected in both the quantitative and the qualitative data. There were a few age-related similarities in the quantitative and qualitative datasets: among both student teachers and practising teachers, for example, members of the youngest group (18–28-year-olds) showed the most interest in hedonistic aspirations. Moreover, work was important among the youngest group of students as well as the oldest group of practising teachers. With regard to educational background, students who were aiming to become class and Kindergarten teachers differed from those aspiring to be subject teachers: the class teachers specifically highlighted happiness, hedonism, and helping others (social), whereas the Kindergarten teachers emphasised relationships, helping others, work, political influence, as well as hedonistic and economic interests.

Table 3. The contents of the Finnish students' and the practising teachers' aspirations in relation to gender, age, and education.

	Student Teachers *N* = 912									**Practising Teachers *N* = 77**		
	Gender			Age			*Education*			*Gender*	*Age*	*Education*
	r_s	$\chi^2(1)$		r_s	$\chi^2(2)$		r_s	$\chi^2(2)$		$\chi^2(1)$	$\chi^2(2)$	$\chi^2(2)$
Happiness		33.181 ***	Fem		0.778			14.133 **	C	1.192	0.708	0.933
Relationships	0.217 **	9.665 **	Fem	−0.058	1.586		−0.246 **	10.378 **	K	0.811	0.082	1.079
Work		5.952 *	Fem		7.553 *	18–28		7.805 *	K	0.883	9.126 * 40–	1.793
Self-actualization		6.542 *	Fem		1.246			1.814		0.497	0.743	0.041
Hedonism	0.089 **	0.004	Fem	−0.239 **	8.093 *	18–28	−0.179 **	2.983	C,K	0.014	7.467 * 18–28	0.756
Social	0.149 **	0.016	Fem	0.030	0.570		−0.170 **	0.086	C,K	0.755	5.103	2.743
Political influence	−0.053	3.063		−0.011	2.611		−0.111 **	2.696	K	0.001	3.384	1.798
Economic	0.090 **	0.525	Fem	−0.146 **	8.517 *	18–28	−0.119 **	9.334 **	K	0.245	0.720	1.876
Religion	−0.002	1.396		0.033	1.318		−0.033	1.415				
Health		0.392			1.626			3.526		0.082	3.000	0.239
Aesthetics	−0.042	6.428 *	Male	0.026	0.905		0.000	1.387		0.245	0.720	4.559

r_s = Spearman's non-parametric correlation; χ^2(d) = Pearson's chi-square. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Compared groups: Gender: Fem = Female, Male; Age: 18–28, 29–39, 40–; Education: K = Kindergarten teacher (only student teachers), C = Class teacher, S = Subject teacher, Sp = Special education teacher (only practising teachers).

When we looked at self- and BTS-orientation on the individual teacher level (Table 4) we noticed that about half of the respondents had expressed only a self-orientation in their answers ($n_{\text{student teacher}} = 420$; 46%; $n_{\text{practising teacher}} = 42$; 55%). Around 40 per cent had manifested BTS-orientation ($n_{\text{student teacher}} = 392$; 43%; $n_{\text{practising teacher}} = 28$; 36%), including those who only focused on others or who combined a self- and BTS-orientations. Finally, we were able to identify a family orientation ($n_{\text{student teacher}} = 54$; 6%; $n_{\text{practising teacher}} = 2$; 3%), mention of their own family being the only indicator of taking into account the perspectives of others. No statistically significant differences were found between orientation and gender or education. However, there was a statistically significantly association with age among

the student teachers: self-orientation was supported by over half of the 18–28-year-olds (n = 314, 53%) whereas the numbers were lower in the other groups (29–39-year-olds n = 82, 36%; over 40-year-olds n = 25, 29%).

Table 4. Purpose orientations.

Orientations	Student Teachers N = 912	%	Practising Teachers N = 77	%
Self	421	46	42	55
Beyond-the-self (Other or self + other)	391	43	28	36
Family as the only other	54	6	2	3
No purpose	37	4	1	0
No answer	9	1	4	5

3.2. Finnish Teachers Incorporating Professional Aspects into Their Life Purposes

As shown in Table 2, work ($n_{\text{student teachers}}$ = 311; 34%; $n_{\text{practising teachers}}$ = 11; 14%) was among the major contents of purpose. The student teachers wanted to find work that was meaningful and purposeful. Ten per cent (n = 100) of student teachers explicitly mentioned teaching as their dream, calling or purpose: "My purpose in life is to teach what I can and whom I can, to help others to grow and to understand life" (Student teacher 1064). "(For me the most important purpose is to have a happy relationship and family life) and secondly to defend children's rights to a good life and participate in their upbringing as a Kindergarten teacher" (Student teacher 1330). The majority of participants used words such as work, job and occupation, which in the context of teacher education and school could be interpreted as referring to the teaching profession. Nevertheless, some student teachers seemed to refer to other occupations, and some wrote about their uncertainty with regard to their professional path: "Professionally I do not have a clear purpose, even though I am studying to become a teacher" (Student teacher 4129).

When the practising teachers were asked directly how teaching related to their purpose, the majority (n = 60; 78%; Table 5) replied that their aspirations were actualised in teaching, which brought happiness, meaning, learning experiences, and opportunities for self-actualisation: teaching was seen as a mediator, indicating self-orientation. The respondents also pointed out that teaching offered opportunities to help and guide children and young people, thereby demonstrating a BTS-orientation. A few (n = 5; 6.5%) did not see a link between their purpose and teaching, and some (n = 12; 15.5%) gave unclear answers.

Table 5. Teachers' perceptions on how teaching manifests in their life purposes.

Categories	Practising Teachers N = 77 (%)
Teaching as a mediator	60 (78)
Beyond-the-self-orientation (Other or self and other)	34 (44)
Self-orientation	26 (33)
No role	5 (6.5)
Unclear answer	12 (15.5)

4. Discussion

In this article we have discussed the challenge of educating purposeful teachers in Finland. Given the new demands of the 21st century and the decreasing number of teacher candidates in Finland, we perceive a need for more emphasis on meaningful teacher education that combines the personal and professional interests of future teachers. We analysed data from student teachers (N = 912) and practising teachers (N = 77) to find out what purposes Finnish teachers considered important in their lives and how they incorporated professional aspects into their life purposes.

We assessed the interests of Finnish student teachers using Roberts and Robins's [21] Life Goal Questionnaire, and we found that relationships and hedonistic goals were the

most valued, and economic matters, religion, aesthetics and political influence were the least important. These results align with those reported in the original study conducted among American undergraduate students [21] and Finnish university students of social services [26]. However, qualitative content analysis of the student and the practising teachers' own descriptions revealed that Roberts and Robins's categories did not capture all of the major content categories, namely happiness, work, and self-actualisation. All in all, happiness and relationships were the most frequently mentioned contents, as they were among Finnish students of social services [26]. These contents also reflected the goals and values identified in national samples of Finnish youth and young adults [30].

In addition to analysing the content categories, we also considered the beneficiaries of the teachers' aspirations: whether their aspirations demonstrated a self-orientation, or whether they were interested in contributing beyond-the-self. The results showed, first, that all contents were associated with both orientations, illustrating empirically that even hedonistic goals may benefit others, and that social purposes (interest in helping and volunteering) may include self-focused motivations. Second, they imply that using only content categories as indicators of self- or beyond-the-self -orientation might not be enough [6,31], thereby highlighting the need to develop qualitative approaches that illustrate how individuals construct meanings and connect them to their aspirations. Nevertheless, contents related to social issues, political influence and religion were generally strongly allied with beyond-the-self-orientation, whereas all other contents related mainly to self-orientation.

We also found that most of the descriptions of the students and the practising teachers were self-oriented, indicating that within Damon et al.'s [4] and Tirri's [1] framework these participants did not exhibit the purpose or the profile of a purposeful teacher. Further, for some the other-focus referred only to their own family. Self-orientation was especially prevalent among the youngest student teachers, aged 18–28. There was a visible association between personal life purpose and work in 34 per cent (n = 311) of the student teachers' and 14 per cent (n = 11) of the practising teachers' statements, but only ten per cent in total explicitly mentioned teaching as their dream, calling, or purpose. Moreover, work was referred to mainly as self-beneficial and only a minority of the participants mentioned serving other people, society, or other noble causes. The majority of the teachers did not refer to teaching in their answers at all, nor did they consider it important to contribute to the well-being of other people or society. However, when the practising teachers were asked directly how their purpose in life was associated with their work, over half of them identified a link: teaching was seen as a mediator in realising their personal purposes or aspirations. Through teaching they could make their own life meaningful, actualise themselves, and contribute to the lives of others.

From the perspective of the purposeful teacher, the results of the present study reveal challenges for teacher education. Finnish teachers seem to be rather self-oriented, interested in their own meaning-making, and in what benefits themselves. The rather strong prevalence of self-orientation among Finnish student teachers and practising teachers could be one possible explanation for teacher burnout and attrition, since according to previous empirical studies, self-orientation does not help individuals to face and cope with challenges as well as focus on benefitting others [32]. Teacher education in the twenty-first century should therefore nurture more beyond-the-self -orientation in teachers and explicitly help them build bridges between personal purposes and the teaching profession. This kind of approach could support professional learning among teachers, especially from a motivational perspective [3]. The educational system in Finland is well known for its whole-person approach that takes into consideration not only the cognitive but also the affective, behavioural, moral, social, physical, and spiritual domains [33]. Given the results of this study, it seems that Finnish teacher education has not been able to actualise this approach in its programs.

Thus, our results indicate the need for a whole-person approach to teacher education that helps prospective teachers to reflect on and develop their purposes, from self-orientation towards beyond-the-self orientation. Concretely, Finnish universities should

establish opportunities in teacher education to reflect on teacher ethics and purposeful teaching [18]. Some methods have already been developed. Tirri and Kuusisto [34], for example, have presented a case-study approach in which teachers learn to analyse teaching-studying-learning experiences and to identify elements that make teaching purposeful and learning personally meaningful. Nevertheless, findings from the present study indicate that more systematic procedures and policies are needed to build more sustainable approaches.

The study has several limitations. First, even though we had extensive data from student teachers, the practising teachers represented only one Finnish basic-education school, and the sample (N = 77) is too small to draw generalisable conclusions. Second, both datasets were cross-sectional in nature, which means that the study gives a state-of-the art overview and as such contributes to both fields of study, namely teacher education and purpose, but it does not identify the developmental aspects of life purposes among teachers. Longitudinal research and intervention are needed to find out how purpose develops during pre- and in-service teacher education, and how whole-person approaches support the development of personal and professional purposes and their meaningful integration. Third, considering the relatively short nature of the written statements, a series of in-depth analyses of interviews with focus groups and privileged witnesses, and of narrative writings could provide a more nuanced and deeper understanding of teachers' life purposes and their links to teaching.

To conclude, the findings of the present study have implications concerning research and practice in teaching and teacher education. Teacher education needs ethical frameworks and moral goals that promote the education of good individuals and citizens for the twenty-first century who find meaning and purpose in serving others. In this paper, we have found the purposeful teacher as a challenge but also a moral goal for teachers of the twenty-first century. With these contributions we hope to advance purposeful education and advocate the development of purposeful teaching that could be applied in teacher education around the world.

Author Contributions: Conceptualization, methodology, validation, E.K. and K.T.; writing—Original draft preparation, E.K.; writing—Review and editing, E.K. and K.T.; project administration, E.K.; funding acquisition, K.T. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported in part by a subcontract (grant number 2013-053) from Clark University to the University of Helsinki (Kirsi Tirri, PI), based on a grant to Clark University (Seana Moran, PI) from The John Templeton Foundation, USA. The opinions expressed in this article are of the authors and do not necessarily reflect the opinions of The John Templeton Foundation.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the tudy.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Tirri, K. The purposeful teacher. In *Teacher Education in the 21st Century*; Monyai, R., Ed.; IntechOpen: London, UK, 2019. [CrossRef]
2. Kansanen, P.; Tirri, K.; Meri, M.; Klokfors, L.; Husu, J.; Jyrhämä, R. *Teachers' Pedagogical Thinking, Theoretical Landscapes, Practical Challenges*; Peter Lang: New York, NY, USA, 2000.
3. Boeskens, L.; Nusche, D.; Yurita, M. *Policies to Support Teachers' Continuing Professional Learning: A Conceptual Framework and Mapping of OECD Data*; OECD Education Working Paper No. 235; OECD: Paris, France, 2020. Available online: http://www.oecd.org/education/policies-to-support-teachers-continuing-professional-learning-247b7c4d-en.htm (accessed on 5 January 2021).
4. Damon, W.; Menon, J.; Bronk, K.C. The development of purpose during adolescence. *Appl. Dev. Sci.* **2003**, *7*, 119–128. [CrossRef]
5. Frankl, V.E. *Man's Search for Meaning*; Pocket Books: New York, NY, USA, 1988.
6. Moran, S. Purpose: Giftedness in intrapersonal intelligence. *High Abil. Stud.* **2009**, *20*, 143–159. [CrossRef]
7. Damon, W. *Noble Purpose*; Templeton Foundation Press: London, UK, 2003.
8. Day, C. Teachers' moral purposes: A necessary but insufficient condition for successful teaching and learning. In *Encyclopedia of Teacher Education*; Peters, M., Ed.; Springer: Singapore, 2019. [CrossRef]
9. Tirri, K.; Husu, J.; Kansanen, P. The epistemological stance between the knower and the known. *Teach. Teach. Educ.* **1999**, *15*, 911–922. [CrossRef]
10. Han, H. Purpose as a moral virtue for flourishing. *J. Moral Educ.* **2015**, *44*, 291–309. [CrossRef]

11. Harrison, T. Virtue ethics in teacher education. In *Encyclopedia of Teacher Education*; Peters, M., Ed.; Springer: Singapore, 2019. [CrossRef]
12. Trade Union of Education in Finland. Ethical Principles of Teaching. 2020. Available online: https://www.oaj.fi/en/education/ethical-principles-of-teaching/teachers-values-and-ethical-principles/ (accessed on 5 January 2021).
13. Trade Union of Education in Finland. Comenius Oath. 2017. Available online: https://www.oaj.fi/en/education/ethical-principles-of-teaching/comenius-oath-for-teachers/ (accessed on 5 January 2021).
14. Oser, F. Professional morality: A discourse approach (the case of the teaching profession). In *Handbook of Moral Behavior and Development*; Kurtines, W., Gewirtz, J., Eds.; Lawrence Erlbaum Associates: Hillsdale, NJ, USA, 1991; Volume 2, pp. 191–228.
15. Tirri, K.; Husu, J. Care and Responsibility in 'The Best Interest of the Child': Relational voices of ethical dilemmas in teaching. *Teach. Teach.* **2002**, *8*, 65–80. [CrossRef]
16. Clydesdale, T. *The Purposeful Graduate*; The University of Chicago Press: Chicago, IL, USA, 2015.
17. Deresiewicz, W. *Excellent Sheep: The Miseducation of the American Elite and the Way to a Meaningful Life*; Free Press: New York, NY, USA, 2014.
18. Colby, A. Purpose as a unifying goal for higher education. *J. Coll. Character* **2020**, *21*, 21–29. [CrossRef]
19. Damon, W. *Path to Purpose. How Young People Find Their Calling in Life*; Free Press: New York, NY, USA, 2008.
20. Moran, S. *How Service-Learning Influences Youth Purpose around the World, Student Semester Start Survey*; Qualtrics Version; Kuusisto, E.; Tirri, K., Translators; Clark University: Worcester, MA, USA, 2014. (In Finnish)
21. Roberts, B.W.; Robins, R.W. Broad dispositions, broad aspirations: The intersection of personality traits and major life purposes. *Personal. Soc. Psychol. Bull.* **2000**, *26*, 1284–1296. [CrossRef]
22. Bundick, M.; Andrews, M.; Jones, A.; Mariano, J.M.; Bronk, K.C.; Damon, W. *Revised Youth Purpose Survey*; Stanford Center on Adolescence: Stanford, CA, USA, 2006.
23. Magen, Z. *Exploring Adolescent Happiness: Commitment, Purpose, and Fulfilment*; Sage: Thousand Oaks, CA, USA, 1998.
24. Natow, R.S. The use of triangulation in qualitative studies employing elite interviews. *Qual. Res.* **2020**, *20*, 160–173. [CrossRef]
25. Elo, S.; Kyngäs, H. The qualitative content analysis process. *J. Adv. Nurs.* **2008**, *62*, 107–115. [CrossRef] [PubMed]
26. Manninen, N.; Kuusisto, E.; Tirri, K. Life goals of Finnish social services students. *J. Moral Educ.* **2018**, *47*, 1–11. [CrossRef]
27. Tirri, K.; Kuusisto, E. What is purpose in life among Finnish theology students? In *Understanding Religion: Empirical Perspectives in Practical Theology: Essays in Honour of Hans-Georg Ziebertz*; Riegel, U., Heil, S., Kalbheim, B., Unser, A., Eds.; Waxmann: Münster, Germany, 2019; pp. 97–108.
28. McHugh, M.L. Interrater reliability: The kappa statistic. *Biochem. Med.* **2012**, *22*, 276–282. [CrossRef]
29. Tirri, K.; Quinn, B. Exploring the role of religion and spirituality in the development of purpose: Case studies of purposeful youth. *Br. J. Relig. Educ.* **2010**, *32*, 201–214. [CrossRef]
30. Salmela-Aro, K.; Aunola, K.; Nurmi, J.-E. Personal goals during emerging adulthood: A 10-year follow up. *J. Adolesc. Res.* **2007**, *22*, 690–715. [CrossRef]
31. Bundick, M.J.; Tirri, K. Student perceptions of teacher support and competencies for fostering youth purpose and positive youth development: Perspectives from two countries. *Appl. Dev. Sci.* **2014**, *18*, 148–162. [CrossRef]
32. Salmela-Aro, K.; Nurmi, J.-E. Goal contents, well-being and life context during transition to university—A longitudinal study. *Int. J. Behav. Dev.* **1997**, *20*, 471–491. [CrossRef]
33. Tirri, K.; Kuusisto, E. How Finland Serves Gifted and Talented Pupils. *J. Educ. Gift.* **2013**, *36*, 84–96. [CrossRef]
34. Tirri, K.; Kuusisto, E. How can purpose be taught? *J. Relig. Educ.* **2016**, *64*, 101–112. [CrossRef]

education sciences

MDPI

Article

Safe Space, Dangerous Territory: Young People's Views on Preventing Radicalization through Education—Perspectives for Pre-Service Teacher Education

Saija Benjamin [1,*], Visajaani Salonen [1], Liam Gearon [2], Pia Koirikivi [1] and Arniika Kuusisto [1,3]

[1] Faculty of Educational Sciences, University of Helsinki, 00100 Helsinki, Finland; saivisajaani.salonen@helsinki.fi (V.S.); pia.koirikivi@helsinki.fi (P.K.); arniika.kuusisto@buv.su.se (A.K.)
[2] Department of Education, University of Oxford, Oxford OX1 2JD, UK; liam.gearon@ox.ac.uk
[3] Department of Child and Youth Studies, University of Stockholm, 114 19 Stockholm, Sweden
* Correspondence: saija.benjamin@helsinki.fi

Abstract: Initiatives for preventing radicalization and violent extremism through education (PVE-E) have become a feature of global educational policy and educational institutions across all phases, from early childhood to universities, also in Finland. If schools may be regarded as safe spaces here for identity and worldview construction and experiences of belonging, the specific subject matter of PVE-E is also dangerous territory. Not least because of PVE-E's focus on radicalization, but above all because of perceptions of schools being used as an adjunct of governmental counter-terrorism policy. We argue that understanding young people's views on issues related to radicalization and violent extremism is critical in order to develop ethical, sustainable, contextualized, and pedagogical approaches to prevent hostilities and foster peaceful co-existence. After providing some critical framing of the Finnish educational context in a broader international setting, we thus examine young people's views (n = 3617) in relation to the safe spaces through online survey data gathered as a part of our larger 4-year research project *Growing up radical? The role of educational institutions in guiding young people's worldview construction*. Specifically focused on Finland but with potentially wider international implications, more understanding about the topic of PVE-E is needed to inform teacher education and training, to which our empirical data makes some innovative contribution.

Keywords: prevention of violent extremism through education; safe space; dangerous territory; teachers' beliefs; teachers' skills; identity; worldviews

Citation: Benjamin, S.; Salonen, V.; Gearon, L.; Koirikivi, P.; Kuusisto, A. Safe Space, Dangerous Territory: Young People's Views on Preventing Radicalization through Education—Perspectives for Pre-Service Teacher Education. *Educ. Sci.* **2021**, *11*, 205. https://doi.org/10.3390/educsci11050205

Academic Editors: Kirsi Tirri and James Albright

Received: 29 March 2021
Accepted: 23 April 2021
Published: 27 April 2021

1. Introduction

The rise of nationalism, the threat of terrorism, and the seeming increase in violent attitudes all appear omnipresent in public debate, in Finland as in other countries. In many countries, children and young people are as often part of the story as the adults. Thus, although there have not been large-scale acts of violence and indeed the incidents classified as terrorism in Finland are scarce, the school shootings in Finnish educational institutions in recent history shocked the nation and left incisions, especially in the collective memory and sense of security of young people [1].

The challenges these developments pose for societies and their educational institutions are growing and becoming more complex [2–5]. As possible approaches for the prevention of violent attitudes, radicalisation, and extremism in education, authorities and scholars from various fields have suggested, for example, peace education [6], citizenship education [7], religious education [8], or fostering of national values [9]. With a focus on promoting non-violent dispositions, increasing awareness and understanding of others, and caring for the welfare of others in a peaceful manner [10], education on peace, democracy, and human rights can be seen as opposite for violence, radicalisation, and extremism, and thus considered as potential means towards combatting and preventing these [11–13].

Human rights and the international system that supports them have, however, also been characterized and critiqued as being themselves part of the problematics of a dominant global north, and this a source of conflict and dissent [14,15]. This has become especially apparent in recent debates around "decolonising the curriculum" [16].

Contentious matters aside, the issues of violence and extremism are never actually far from the surface of international educational policy. Yet, while traditions of human rights and cultural understanding have a long tradition in Finnish education [17], policy and research on the prevention of violent extremism, physical and ideological, has become a new phenomenon in Finland, as it has worldwide [4,18,19]. Rather novel as a specific field of study, the manner in which PVE-E has emerged is quite extraordinary, though the jury, so to speak, is out on the actual effectiveness of such programmes, including in teacher education and training [20]. Many questions therefore remain open when it comes to the prevention of violent extremism through education (PVE-E) in the institutional context, especially in the pedagogical sense.

In sum, initiatives for the countering and preventing violent extremism through education (PVE-E) have become a feature of global educational policy and educational institutions across all phases, from early childhood to universities. If schools may be regarded as safe spaces here for a pastorally sensitive reflection on matters of child safety and harm, the specific subject matter of PVE-E is also dangerous territory. Not least because of PVE-E's focus on radicalization, but above all because of perceptions of schools being used as an adjunct of governmental counter-terrorism policy. For the purposes of developing pre-service teachers' knowledge here—PVE-E policies now involving the educational systems they will enter—understanding young people's views on issues related to radicalization and violent extremism form, we argue, a critical element in policy and pedagogical critique. After providing some critical framing of the Finnish educational context in a broader international setting, we thus examine young people's views in relation to these issues, data gathered as a part of our 4-year research project *Growing up radical? The role of educational institutions in guiding young people's worldview construction.* Specifically focused on Finland but with potentially wider international implications, more understanding about the topic of PVE-E is needed to inform teacher education and training, to which our empirical data makes some innovative contribution.

2. Worldviews and Values in Finnish Education

Education, especially through the formal system of schooling, is one of the core processes through which communities, such as nations, socialize their younger generations and thereby also create and maintain societal cohesion. By transmitting those values and ideas that the society regards important, formal education strengthens the idea of a collective identity and the unity of the group, such thinking is increasingly an important part of international educational policy, including but extending far beyond programs of citizenship [21,22].

Often with a pervasive multidimensional dimension of inherited and acquired culture, worldview is here referred to as an individual's unique ontological, epistemological, and ethical orientation to the environment [23] and the ontological foundation for values, beliefs, and knowledge used in meaning-making and for making choices [24]. Worldview functions as a philosophy of life, which is in a critical role in understanding reality and in providing satisfying meanings to life questions. It may also refer to group values and epistemologies, which function to define understandings of what can be known and how to construct ideas of oneself and "the other" [25,26]. Children and youths' worldviews are increasingly hybrid in nature, merging elements from a variety of religious, secular, etc. sources or traditions [27], and new forms of often very individualized spirituality [28,29].

To discuss prevention of radicalization and extremism, in other words, countering of worldviews and mindsets that are considered as harmful or dangerous and thus preventable, it is necessary to first define those values and worldviews that are considered as normative and accepted and in line with societal status quo [4]. Finland's educational

system is based on an ethos of equality and inclusion [30,31]. There are very few private schools in Finland and all levels of pre-primary, basic, upper secondary, and university education are publicly funded and aimed to be inclusive of all children. School education in Finland is based on the values of humanity, equity, and democracy, stated in the National Core Curricula [31]. While the foreign-born population is still relatively small [32], plurality of attitudes and worldviews is increasing in Finland, which is also demonstrated by the growing demand for school education in different religions and mother tongues, which are offered for pupils based on their guardian's request [33]. The Finnish model of religious and secular ethics education has been praised for the ways in which it supports the freedom of religion identified in the universal declaration of the human rights [34]. However, the model has also been strongly criticized for separating the students according to their memberships, as well as for the fact that students do not necessarily identify themselves with the tradition they are assigned to [35]. Although the school system is officially non-denominational, Finland has a strong connection to the Evangelic-Lutheran church in its history and this has created a national hegemony that, despite secularization, impacts several layers of the society, including basic education. Despite the remarkable decrease in memberships of the Lutheran Church in the past decades, a vast majority of Finns (71%) affiliate with Lutheranism [36] at least nominally, and consider Lutheranism as part of "Finnishness". While this percentage does not necessarily tell much about the ways in which people identify as being religious or non-religious, it provides an example of the hegemonic position that Christianity has had, and still has, in being the main religious tradition in Finland.

While the objectives of school education are defined in the national curricula, in reality, educational institutions and individual teachers have great autonomy to decide the teaching practices and learning contents. This type of setting emphasizes the significance of individual teachers and their subjective values, worldviews, and understandings about the moral foundations and complexities of those of the others. Unconscious or conscious, these moral and ethical underpinnings underlie all education, from planning to pedagogical practices to assessment. Especially central they become when addressing sensitive, topical themes in the classroom, which lie at the basis of education for the prevention of radicalisation and extremism [37,38].

3. Prevention of Radicalization in Finnish Education

Extremism and terrorism receive amplified media attention in Finland as elsewhere in the Western world [39], which shows, for example, in young people's increased worry about terrorism [40,41] and the government's emphasis of the role of the educational sector in the national action plan for prevention of radicalisation and violent extremism [4,42]. Although studies show that the majority of young people in Finland are doing well [43,44] and that violent crime among young people has decreased [45], the suggested responsibilities for educational institutions to partake in the national prevention of radicalisation and extremism is well grounded: societal polarization, various extremist movements, and attacks are in the rise [46,47] and young people's exposure to propaganda, disinformation, racism, and hate speech has increased. Teachers—working and interacting with young people on a daily basis—are at the forefront of these trends as they get to witness and address first-hand the effects and consequences that the various conspiracy theories and extremist ideologies spreading online may have on children and youth.

However, to implement PVE-E policies in schools is not straightforward a mission, as, for example, in the light of the increasing value and worldview pluralism in the Finnish society and classrooms, it becomes challenging for the teachers to define the kinds of values and ideologies that should be endorsed and what should be proscribed in formal education. This ambiguity is reinforced by public debates where the focus of tolerance is often narrow—the social norms and the societal spectrum of normality, especially regarding values (see [48]), pose limits to which group or worldview is promoted, and which ones are perhaps merely "tolerated", or discriminated against [49]. Obviously, there is a lot of

variety and nuance in between any ideological or religious extremes, so a clear demarcation of worldviews that are endorsed in education and those regarded as extremist and harmful needs careful consideration.

Our previous studies highlight the need to plan PVE-E strategies in line with national educational policies through what we conceptualize as "institutional habitus" [4,18]. This means that, for example, in the Finnish context, strategies based on profiling or monitoring students, deployed in some countries [50], may not seem on the surface appropriate for the Finnish educational culture, which is based on trust and the values of humanity, equity, and democracy [4,30,31]. Regardless of interpretation or worldview, human rights and non-violence can be considered as an indisputable frame of reference when defining models of thought and action that need to be prevented at school. These are also included in the fundamental rights defined by the Finnish constitution, on which the value base and curricula of formal education are based. In this light, it can be concluded that all values, beliefs, and intentions that are contrary to the fundamental rights and curricula and that may lead to violent speech and/or actions should be considered as preventable. Despite these clear boundaries, a lot of interpretive variation remains regarding the ways certain values are held, for example, patriotism and nationalism.

In the national action plan for PVE-E, the role of formal education is viewed as twofold: on the one hand, children and young people must be encouraged to think critically and learn to peacefully engage in democratic citizenship, but on the other hand, attitudes and activism must be prevented from turning into violent acts and extremism [42]. As the objectives of the core curricula and the suggested PVE-E strategy are well aligned, the focus of PVE-E is set on the prevention of polarization of children's and young people's attitudes through a holistic approach based on the objectives and contents already defined in the national curricula and existing organizational structures in ways that strengthen each students' inclusion, well-being, identity construction, and critical thinking [42,51].

Our recent studies on Finnish upper secondary and vocational school students (ages 16 to 20) indicate that the Finnish students share these national strategic aspirations. The findings indicate that the students themselves see the role of educational institutions as central in the prevention of violent attitudes and radicalization. The first of these studies [18] examined upper secondary school students' answers to a matriculation examination question titled "Assessing Radicalization" (ages 16 to 20, $n = 1675$). Of particular interest in the research analysis was the way young people see the role of school in the prevention of radicalization. The findings showed that young people see social and educational inequalities as explanatory factors for radicalization and perceive school as an enabler of social equity. In this sense, the students' answers seem to reflect and be in line with the societal ideal, as traditionally in Finland, educational institutions are viewed as contexts where children and young people from all backgrounds meet as equal individuals and acquire equal opportunities in life. Students also stressed the importance of education in increasing one's cognitive capital. They emphasized the need to broaden and diversify one's epistemic foundation, meaning knowledge about different cultures and religions, and skills needed to assess knowledge, such as critical thinking and media literacy. These, the students think, allow for perspective-taking and more independent thinking, which they view as key factors in the prevention of radicalization. Several studies support this idea [3,52,53], and similar skills have been highlighted in several other national prevention strategies [54]. The students also brought forth the significance of school as a social environment. They viewed ostracism as a predisposing factor to radicalization, and related to this, pointed to experiences of bullying and discrimination in school in particular. Combating and preventing bullying and discrimination were considered important in order to experience the school as a safe and inclusive environment in which all learners can grow towards full membership in society. According to our results, the students held that together with teacher-led discussions on different values, worldviews and sensitive issues, the fostering of students' independent thinking and feeling of school belonging could work as effective antidotes to radicalization and extremism.

In a subsequent study [43], we examined Finnish upper secondary school and vocational school students' (ages 16 to 20, n = 3617) views on how education could prevent and reduce the formation of violent attitudes among young people, and instead, promote attitudes that convey acceptance of diversity and equality between different people. Again, the findings showed that the students regarded access to unbiased information about other people, religions, and ideologies as key to reduce violent attitudes. The findings also brought forth that the students were aware that the information they receive from different sources, including teachers, may be distorted, fake, or presented from a biased perspective depending on the worldview of the speaker. This highlights the topical global concern about the reliability of knowledge and the confusion related to the trustworthiness of different sources of information (see e.g., [55]). The students were cognizant of a need to strengthen their abilities to critically interpret and evaluate knowledge. To do this, they called for settings where all topics and sensitive issues could be evaluated, criticized, and scrutinized together with the teacher safely and calmly from multiple viewpoints. Related to this, the students underlined the importance of learning how to negotiate and debate and other skills related to reconciliation and conflict resolution [43].

While the students recognized broadening one's epistemic foundation as key to reduce violent attitudes, the findings also highlighted the role of the school as a social community. Students underlined the importance of exposure and contact between different students, as social encounters and contact between different people within the school were perceived to reduce hostility and prejudices—thereby, their views are aligned with Allport's (1954) classic contact hypothesis theory [56]. According to the students, fostering the feeling of togetherness would be a way to counter bullying and violent attitudes, to reduce loneliness and enhance openness to the other. This could be done, as proposed by students, for example, by mixing the students in projects during classes and organizing school-wide events engaging all students and staff. Interaction was seen as important, because according to the students, loneliness and ostracism increase hostility towards others. These findings thus show that a mere increase in epistemic knowledge does not suffice for fostering positive intergroup attitudes among youth, but suggest that the development of a "sense of belonging to a broader community and common humanity", posited as an essential objective for education for a sustainable future by Unesco [57], necessitates positive and inclusive experiences and practices within the school context.

4. Schools as Safe Spaces: Thinking through Dangerous Territory

There is much literature on the notion of cultural space [58,59]. In educational terms, there are corresponding notions of schools as safe spaces [60,61]. Yet, there are tensions here and this is contested subject matter. Davies [50] (2016) asks, for instance, is all this talk of security and indeed safety about safeguarding or surveillance? Thus, along with the many challenges to introducing notions of security in educational environments, the notional idea of school as a safe space for consideration of challenging topics means the same space represents an encounter with dangerous territory.

Prevention of radicalization and extremism are typically approached from the perspective of counter-terrorism and public safety, one which increasingly impacts all aspects not only of European but global public policy on security [62–64]. Consequently, this has had an impact on many PVE-E strategies where aspects of safety and security have gained increasing prominence [62,65–67]. International debates have long been dominated by openings that consider how—but also increasingly why—educational institutions should detect and identify individuals who are thought to threaten the safety of others with their values or behaviours, or be at risk of "radicalizing" [4,54,68].

This is where the notion of dangerous territory becomes relevant. The types of approaches that focus on monitoring and profiling of the students are often contested, seeming inimical to the ethos of the local education, and across Europe, teachers share some key concerns related to the suggested PVE-E duties [68]. According to studies, identification and reporting duties seem to have increased the prejudices and stigmatisation concerning

students from certain ethnicities and religious groups [50,69]. In some cases, false alarms from school have led to further investigations and interrogations by the authorities, which create stigma and a psychological burden for the student in question [70,71].

Most importantly, teachers seem to be worried about the apparent contradiction between the curricular objectives to foster students' critical thinking and the duties to report observations about certain student rhetoric or utterances that seem to dispute the curricular or national values. From the students' perspective, the fears of being labelled as radicalised have limited the scope, depth, and possibilities of educational discussions on sensitive topics that students want to engage in class and prevented some of them from seeking psychological support from the school's well-being personnel in the fear of stigma [71–75]. Overall, the PVE-E policies approached from a monitoring perspective may heavily undermine the trust of the students and their families in the teachers and the education system as a place of support and help, and have a long-term toll on the well-being of the students [2,5,68,76]. The lack of trust and higher thresholds for seeking socio-emotional support may indeed hinder the general feeling of safety in educational institutions and increase the risk of radicalisation.

Although the Finnish approach to PVE-E is based on fostering well-being and independent thinking instead of assessing risks, the concept of safety, however, emerges as an important concept related to PVE-E in Finland, too. There are classic tensions here in education as elsewhere between notions of liberty, freedom of expression, and the concerns of security. The students in our two studies thus emphasized the school context as a space to learn, explore identities, and scrutinize and understand sensitive topics safely and without a fear of being bullied, excluded, or ridiculed. In this sense, "safety" refers to a "safe space", which is an educational metaphor for spaces concerned with psychological and social benefits and avoidance of harms [77,78]. "Safe space" as a notion has roots in Bhabha's [79,80] "third space" [65,81]. In the educational context, safety is therefore not something that is controlled and imposed from above, but more a feeling emanating from the actors, organizational practices, and ethos of the school environment.

Similar to the concept of safe space, [82] Cavanagh et al. talk about "culture of care" in schools, referring to an explicit recognition of the plurality of values, beliefs, and practices at school, which makes it feel safe for all students to engage, contribute, belong, and feel confident in their own cultural identities [82]. Na'ilah Suad Nasir and Jasiyah Al-Amin [83] write about educational institutions' necessity to function as identity-safe spaces, also for the religious minority students for whom negotiations of religious values in the societal sphere often are "at once intensely private and painfully public" (see also the REDCo project on European youth, [65,81,84]).

In previous research on educational interventions that support student well-being and feelings of safety in school contexts [60,85,86], it is noteworthy that the findings often come down to two main ideas—to support the inclusion and sense of belonging of all students, and to provide opportunities for active, responsible, and meaningful participation. This is comprehensible when taken into account that school contexts that support inclusion, belonging, and opportunities for participation support the satisfaction of the basic psychological needs of the students, namely, autonomy, competence, and relatedness [87,88]. Teachers may foster the satisfaction of these needs by minimizing pressure and control on them, conveying warmth, caring, and respect to the students and acknowledging students' feelings about meaningful topics [88].

5. Educational Institutions and Extremism: Young People's Views

For the purposes of developing pre-service teachers' own knowledge here—PVE-E now involving the educational systems they will enter—young people's views on issues related to radicalization and violent extremism form here an important part, we argue, in understanding issues in and difficulties with the implementation of such policies. Specifically focused on Finland but with potentially wider international implications, more

understanding about the topic of PVE-E is needed to inform teacher education and training, to which our empirical data makes some innovative contribution.

Outlining schools and classrooms as safe spaces for identities and dialogues is necessarily an important starting point, but in order to draft a more multidimensional picture of the youths' aspirations concerning the safe space, we here assess the topics the youth want more knowledge and discussions about. To do this, we introduce the methodological framework of our 4-year research project *Growing up radical? The role of educational institutions in guiding young people's worldview construction* and outline the specificities of the sub-study presented in this paper. For the purposes of the present study, we examined young people's views in relation to the research question: What are the sensitive topics that should be addressed within the safe spaces provided by the school?

6. Data and Method

As part of a larger mixed-method study looking at the ways educational institutions can guide young people in their worldview construction and prevent violent attitudes and actions, we carried out an online survey in several Finnish general upper-secondary schools and vocational institutions (16- to 20-year-old students) in eight municipalities across Finland. The survey consisted of both quantitative and qualitative questions about the students' values, social relationships, views about their life, and their perceptions about other people. A total of 3617 respondents answered the questionnaire during autumn 2019. While the qualitative and other quantitative data are reported in other studies, the sub-study presented in this paper focuses specifically on exploring the answers to one previously unexplored quantitative measure.

Of all respondents of the study, 52% were female and 42% were male, and 5% identified either as "other" or did not want to specify their gender. The race or ethnicities of the respondents were not recorded, as this is not a normative procedure in Finland. The share of responses gained from upper secondary institutions was higher than that from vocational settings, with 82% representation of upper secondary institutions in comparison to 18% from vocational settings (the sample is thus not nationally representative, as in 2020, the national distribution of students' school choice after basic education was 54% (upper secondary schools) and 40% (vocational institutions) [89]). Geographically, the majority of responses (45%) were gained from the Helsinki capital area.

We obtained ethical approvals for the study from the Universities of Helsinki and Oxford and by all of the municipalities in which the educational institutions were located. School headmasters or teachers distributed the link to the survey to the students, but it was highlighted that participation was completely voluntary. Parental consent was not needed because of the age of the respondents. The survey began with a confirmation of voluntariness and full anonymity, explanation of the purpose of the study, and reminder of the right to withdraw from responding at any moment.

To discuss approaches to PVE-E in a pedagogical framework, in the present sub-study, we set to examine the students' perspectives about the role of school in the distribution of knowledge on topics closely related to the theme of radicalization and extremism. For the purposes of the present study, we looked at student responses to the following survey question: "How well has school provided you with knowledge on certain topics, namely, 'religions and worldviews', 'well-being and health, 'extremism and terrorism', and 'peace promotion and conflict resolution' on a scale 1 (poorly) to 5 (very well)?" The students' evaluations provided us with an understanding of those topics that, on the one hand, are well covered and addressed in school, and on the other, of those topics that are sensitive and topical, but that are not sufficiently addressed. Concerning the statistical methods to analyse the data, Chi-square test was used as a tool to determine the proportion differences among groups. Variance analysis ANOVA was used to compare the statistical differences among means of groups. Statistical analysis was made with IBM SPSS Statistics (Version 25) predictive analytics software.

7. Results

The online survey included a question about the students' evaluations of the amount of knowledge they have received on certain topics during their school years, namely, about "religions and worldviews", "extremism and terrorism", "peace promotion and conflict resolution", and "well-being and health". Figure 1 shows the proportions by school type, "High school" meaning academically oriented upper secondary institutions and "Vocational" standing for the vocational institutions.

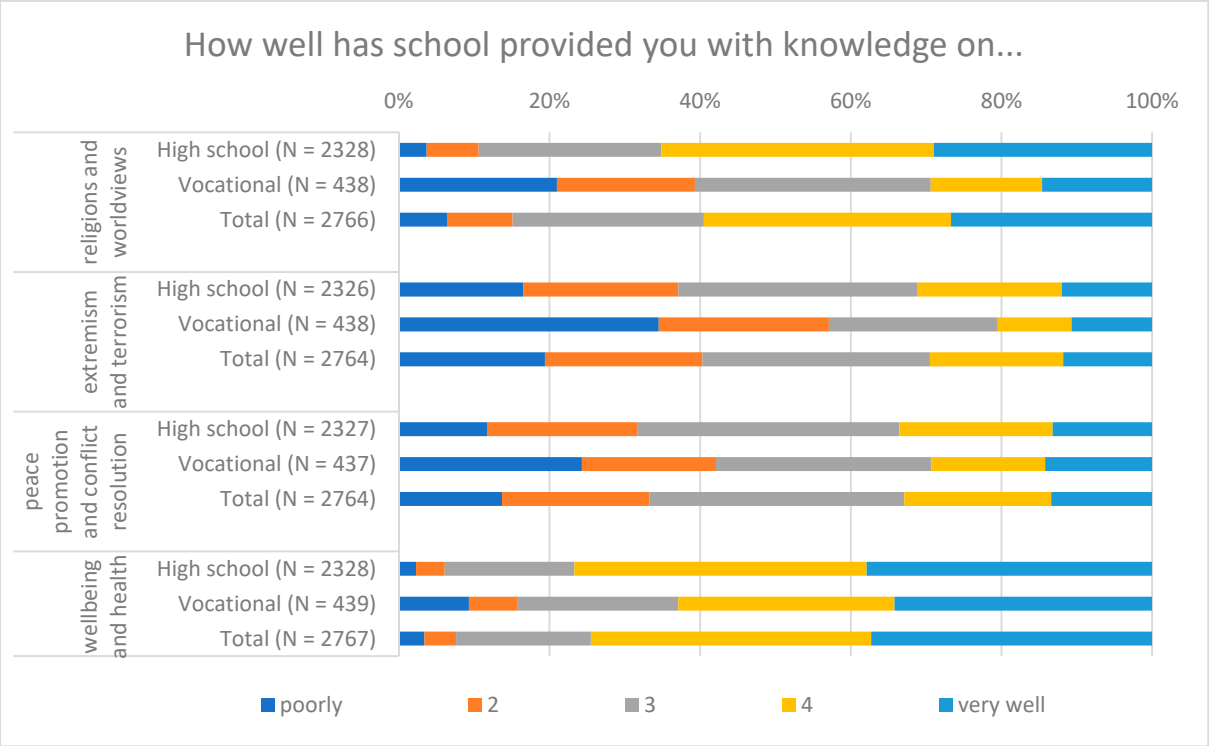

Figure 1. Evaluation of the knowledge received at school, proportions by school type.

When looking at the means and percentages in Figure 1 and Table 1, it can be deducted that of the four topics, the most knowledge the students had received was on religions and worldviews. Sixty percent of the respondents consider that school has provided them information about these "well" or "very well", while only 15% of them think that it was not enough. This is logical, considering that religious education or secular ethics education are compulsory subjects in school from the first grade on, so by the time the students are in secondary education, they have received a minimum of 9 years of religious or secular ethics education [90]. Similarly, 74% of the students considered having received "well" or "very well" knowledge about well-being and health in school, while only 7% of them did not consider it enough. This can also be explained by the fact that health education is a compulsory subject in middle school and the themes related to it are also partly covered in the lessons of physical education. Well-being and health-related themes are also part of the mandatory courses in both upper secondary and vocational institutions.

When looking at the more sensitive topics, 33% of the students view that school has given them "well" or "very well" information about peace promotion and conflict resolution and 30% think the same about the topics of extremism and terrorism. However, when viewed the other way around, the results show that 34% of the students think they have not received enough knowledge about peace promotion and conflict resolution and 40% of them consider the knowledge school provided about extremism and terrorism has not been adequate. This means that more than every third student would want to

receive more knowledge and thus, understanding, about these often controversial and emotion-laden topics.

Table 1. Means for selected variables by school type.

	Religions and Worldviews		Extremism and Terrorism		Peace Promotion and Conflict Resolution		Well-Being and Health	
	Mean	**SD.**	**Mean**	**SD.**	**Mean**	**SD.**	**Mean**	**SD.**
High school	3.8	1.049	2.90	1.236	3.03	1.183	4.06	0.951
Vocational	2.84	1.317	2.40	1.332	2.77	1.349	3.72	1.256
Total	3.65	1.15	2.82	1.265	2.99	1.215	4.01	1.013

When looking at the results by school type, the Chi-square yielded statistically highly significant differences between the school types on evaluations of the knowledge provided in all selected topics (religions and worldviews: X^2 (4) = 313.6, $p < 0.001$; extremism and terrorism: X^2 (4) = 91.7, $p < 0.001$; peace promotion and conflict resolution: X^2 (4) = 52.5, $p < 0.001$; well-being and health: X^2 (4) = 75.5, $p < 0.001$). As presented in Table 1, upper secondary general school students had statistically highly significantly higher mean in every selected variable compared to vocational school students (religions and worldviews: F(1;2764) = 283.70, $p < 0.001$; extremism and terrorism: F(1;2762) = 58.62, $p < 0.001$; peace promotion and conflict resolution: F(1;2762) = 17.38, $p < 0.001$; well-being and health: F(1;2765) = 43.21, $p < 0.001$). The differences between school types reflect more generally the divergent curricula and organizational practices in upper secondary schools and vocational institutions. While general education is emphasized in the former with a large offer of academic courses, the culture of vocational institutions is more focused on learning of professional skills [91]. Of course, we cannot deduct from the answers whether the respondents' evaluations were based on the entirety of their school paths or just the current educational context.

The most significant differences between upper secondary and vocational institutions can be viewed at the level of knowledge provided about religions and worldviews. Partly it can be explained by the fact that religious education (RE) is not studied in vocational institutions, but in upper secondary schools, there are two obligatory courses on RE. As Ghosh et al. [20] have shown, the cultural and religious dimension to countering extremism is important, but it is here as equally important to avoid the automatic association of religion with extremism [92]. In terms of the data, though, the place and portrayal of religion in the curriculum is important. There are thus statistically significant differences between the school types on knowledge provided about extremism and terrorism and peace promotion and conflict resolution as well, but they are relatively smaller. These are topics that are not covered as separate entities in the curricula, but typically addressed within the subjects of history, civics, or philosophy, for example. However, as the teachers in Finland have substantial autonomy in the planning of their lessons, including the methods and materials used, the extent and depth to which these, or any other themes, are covered varies greatly from one teacher to the other, according to their motivation (see e.g., [93]).

When looking at the results by gender classification in Figure 2, the Chi-square yielded statistically highly significant differences depending on gender on evaluations of the knowledge provided in all other topics than religions and worldviews (religions and worldviews: X^2 (8) = 9.4, $p = 0.338$; extremism and terrorism: X^2 (8) = 28.7, $p < 0.001$; peace promotion and conflict resolution: X^2 (8) = 25.7, $p = 0.001$; well-being and health: X^2 (8) = 37.2, $p < 0.001$), again reflecting the role of religious education in the Finnish basic education. As presented in Figure 2, in statistical analysis of means, girls have similar evaluations of the knowledge provided compared to those who do not want to tell their gender or determined themselves as other. The only statistically small difference was found in knowledge offered of well-being and health (F(1;1615) = 6.749, $p = 0.016$), with

girls evaluating having received more information of it than those who identify as other or do not want to tell their gender. This is understandable, as those students whose gender identity deviates from the normative ones do not receive as much institutional or social support in their identity building as do girls and boys [94].

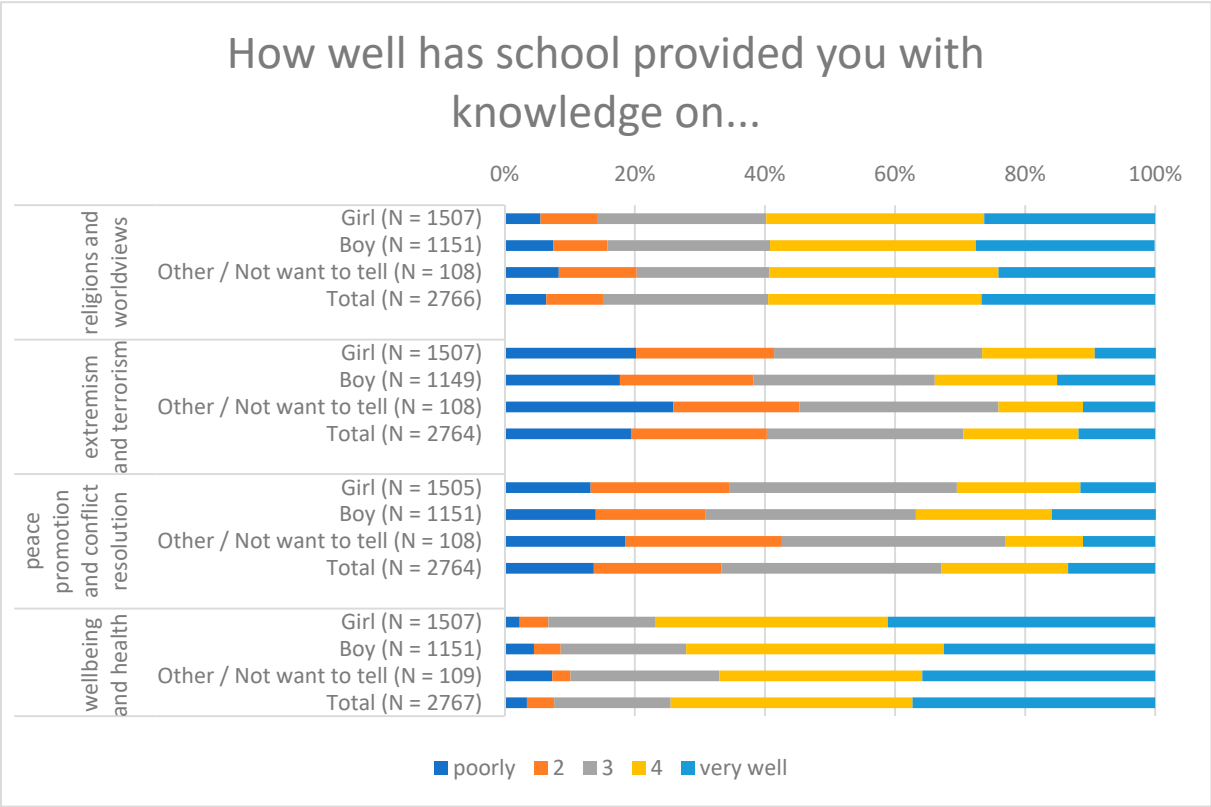

Figure 2. Evaluation of the knowledge received at school, proportions by gender.

Girls had statistically highly significantly lower mean in extremism and terrorism ($F(1;2659) = 3.496$, $p < 0.001$), statistically highly significantly higher mean in well-being and health ($F(1;2659) = 1.567$, $p < 0.001$). Also, girls evaluated the knowledge provided of peace promotion and conflict resolution statistically significantly lower than boys by means ($F(1;2654) = 7.952$, $p = 0.004$). Boys had statistically significantly higher mean on evaluations of the knowledge provided of peace promotion and conflict resolution ($F(1;1257) = 0.003$, $p = 0.006$) and statistically significantly weakly higher mean in extremism and terrorism ($F(1;1260) = 0.301$, $p = 0.02$) than those who determine themselves as other or do not want to tell their gender. The results are interesting, as in practice, all genders have been studying together in mixed classes, and therefore, in theory, should have received the same amount of information of the topics. The significant differences between the evaluations of the knowledge received from school can be partly explained by previous research on motivation and learning that highlight that the more a topic feels personally meaningful and relevant, the more one pays attention to it and seeks for information about it [87].

The results also need to be viewed in the light of the broader societal context. Peace promotion and conflict resolution are themes that are incorporated and debated over in popular youth culture globally [95] and extremism and terrorism are themes that evoke increasing uncertainty and worry in youth globally, but also in Finland [40]. The findings perhaps reflect more broadly the Finnish cultural ethos of peace building and conflict resolution that relate closely to the military service, which becomes a topical theme at adolescence: in Finland, the military service is compulsory for all males between 18 and 60 years of age. The societal pressure for performing military service is strong and while

more and more contested, it is still considered as a traditional rite of passage and a part of identity for many males [96]. Civil service offers a non-military alternative, but still about 67% of the conscripts choose attending the military service, typically right after finishing the upper secondary or vocational education. In fact, according to a recent study, Finnish youths' willingness to attend the military service is increasing as a result of global threats, such as terrorism [97]. Theories on the role of motivation in learning [87] may partly explain why boys evaluate having received more knowledge than other genders on peace promotion and conflict resolution and would want to know more about extremism and terrorism. These two themes can be considered closely related to each other and forming the two sides of the same coin. Although a voluntary military service is also offered for females since 1995 and the number of females in the army is steadily increasing [98], the military service is not a popular choice among non-heterosexual and transgender youth, because it is typically seen as a sexist and homophobic context and best suited for heterosexual men [99].

8. Limitations

Regarding the limitations of the present study, the data is not representative of all Finnish upper secondary or vocational level students, with 82% representation of upper secondary institutions in comparison to 18% from vocational settings, but it has representation from different geographical areas in Finland, both cities and smaller towns and rural areas, and displays varied demographics. Furthermore, we acknowledge that the survey question explored in this study refers to the students' evaluation of the amount of knowledge received of each given topic and cannot be explicitly analysed as an assessment of their opinion about the personal meaningfulness or importance of the topic evaluated. However, the labels of the answer scale ("poorly" and "very well") do include an opinion-mapping connotation and thus give a cue of the personal relevance of each given topic to the respondent.

9. Discussion

9.1. Safe Spaces in Education

In order to prevent hostile attitudes and radicalization in the society, secondary education students in Finland emphasize the role of school as a place to gain objective and diverse knowledge about different cultures, religions, ideologies, values, political systems, and diverse viewpoints. The students regard this knowledge as necessary for the development of awareness, tolerance, perspective-taking, and understanding, especially concerning those who seem different. They consider school as a natural and suitable context for developing these types of cognitive resources, and call for opportunities to reflect and discuss topics related to various cultures, religions, ideologies, values, and other possibly sensitive topics in a safe, non-violent setting, safeguarded by teachers who are urged to make efforts to remain impartial vis-à-vis the various worldviews and perspectives present in the student body. This type of setting could be thought of as a safe space for the exploration and construction of various identities, values, and worldviews, as well as for fostering interpersonal understanding and belonging, and gaining new knowledge.

We suggest that creating safe spaces in schools for discussion and addressing challenging, sensitive topics recognizes safety not only as the absence of harm, such as scorning, bullying, and exclusion, but also as providing students the space to express and discuss their concerns, questions, and opinions, thus giving them the autonomy to become who they are in respect to their identities, values, beliefs, and practices [65,81,82]. While the dignity and safety of the identities of all students must be respected by upholding certain rules regarding the freedom of expression, this type of safe space in school allows for the growth of cognitive resources and social skills in students that are key in the prevention of radicalization and extremism [65,100,101]. These resources and skills, also referred to as "transversal competences" in the Finnish national core curriculum [31], enhance

interpersonal understanding and create means in which dialogue and peaceful co-existence can be advanced on interpersonal, community, and global levels.

9.2. Sensitive Topics and the Polyphony of Voices in the Safe Spaces

Regarding the topics of discussion within these safe spaces, the results of our present study demonstrate that topics related to religion, well-being, and health are typically well-covered in formal education in Finland, as evaluated by the students. However, they also feel that school has not provided them with sufficient knowledge about topics related to extremism and terrorism, and peace promotion and conflict resolution. Nevertheless, these are themes that are omnipresent in the media and surface regularly and spontaneously in daily discussions between the students and the teachers [102]. These sensitive and often identity-related topics evoke curiosity, strong opinions, and feelings, such as fear and uncertainty. It is thus understandable that the students want to discuss these in a safe and calm environment that is conducive to gaining new knowledge, perspectives, and more understanding, as opposed to the discussion platforms on social media that are often tense, polarized, and contribute to even more fear and uncertainty [55]. These themes also become topical at adolescence, as they relate closely to the military service that is compulsory for all young males in Finland. However, it is noteworthy that these are topics that are not allocated to any specific subject in the syllabus, but that may be and typically are addressed within subjects dealing with global and humanitarian issues in general, such as history, civics, religious education, or philosophy. Yet, this depends greatly on the teacher.

While the topics related to extremism, terrorism, and conflicts are stimulating and thought provoking, they may also be challenging to tackle for many teachers [101,103]. Indeed, teachers have reported feeling uncomfortable discussing themes related to terrorism and extremist ideologies with children and youth because of lack of substance knowledge about them. For example, they may feel uncertain to explain to the students the motivations of a terrorist to commit an act and kill people [50] or why some people radicalize while others do not [102]. However, if the youth do not receive support and space in school for dealing with their questions, feelings, and thoughts related to complex phenomena and current local or global incidents, such as terrorist attacks or wars, they may be left with no means of dealing with these themes in a safe environment. In this case, there is a risk that the students will go discuss these topics in forums where simplified answers and solutions are offered to complex phenomena and where the justifications of these views may be considerably biased and irrational.

In a large evaluation of those practices that seem to work in the field of PVE-E to decrease black-and-white, dogmatic views, Davies [50] found out that one key factor for success were teachers who are able to address and discuss controversial and difficult topics with the students while promoting not a moralistic, but a critical stance. By discussing sensitive issues, dissenters are given the opportunity to be heard, but also to assess their own beliefs in a new light. Therefore, instead of condemning certain values or worldviews, the discussion should bring forth all voices, not only of the polarized ones who disagree with each other, but also of those who are uncertain or prefer staying in the middle ground [50]. This means that the perspectives and opinions of all students should be heard while also seeking to discover those experiences and feelings that are shared among most of them.

These findings are especially relevant in the Finnish context, as recent studies show that there are many young people in Finland who are socially excluded or feel they do not belong in the school community or in society at large [104]. Creating inclusive safe spaces where the feeling of belonging of students from all backgrounds is fostered and where everyone becomes visible and heard is one way to address this issue at school. The creation of safe spaces in school is a prerequisite for dialogue and discussion that are central tenets in building connections between people having different perspectives [3]. By providing space and opportunities for open, polyphonic, and unprejudiced dialogue between students who

support different worldviews and ideologies, discussions of nonconformist or deviant ideas and values an be facilitated. Additionally, those ideals of the students that may seem extremist or "adrift" from the society's point of view should be discussed together in school as well as at home, in order to create and restore trust [76,102].

9.3. Teacher Education and the Scaffolding of Safe Spaces

While it is easy to agree with the above-described precepts—crystallizing the objectives of 21st century global education [57]—their implementation in the classroom is, however, much more challenging. To create truly and genuinely safe spaces for all students, added sensitivity is required from the teachers first, to recognize the national hegemonies, norms, and values that drive their actions and intentions often unwittingly, for these types of partly unconscious elements and practices play a central role in the construction of the sense of self, belonging, and acceptance of the values, worldviews, and identities of their students. This is where teacher education has a relevant role in preparing student teachers for the field: the ever diversifying student body in terms of worldviews and identities and the suggested PVE-E policies now entering Finnish education make it important to emphasize and practice student teachers' self-reflection on how their own backgrounds, including elements such as their socio-economic position, cultural heritage, and internalized values, shape the way they filter and interpret the world and its actors [4,25]. All teachers act according to their own epistemological understanding of knowledge and truth and this again influences how they interpret teaching and learning situations. These implicit biases can lead to errors in perception and interpretation of the students' actions and utterances [105]. According to studies, youth are very sensitive in detecting teachers' values in the tone of their voice, the conflicts between what they say and what they do, even in their silences [25,65,81].

Teachers are in a key role in creating safe spaces in school for all students to grow cognitively and socially. To do this, metacognition [106], in other words, skills related to "thinking about thinking", needs to be practiced early in teacher education. Only through thorough self-reflection can one become aware of one's own epistemic foundation (values, beliefs, prejudices, and ways of knowledge acquisition), which is a prerequisite for developing ethical sensitivity [107] and understanding of the epistemic foundation of the others [100]. Teachers' awareness of their own epistemic foundation forms the scaffolding for the safe spaces and help them in guiding discussions on sensitive topics in a more objective way. We believe that such issues are becoming acute in an area such as the prevention of radicalization and extremism through education.

10. Conclusions

Lately, the diversifying societal value landscape together with the rise of violent events and ideologies [46,108] have created pressure for education to address these challenges and to develop the students' abilities to live and thrive in the diversifying societal settings and in the global world. The polyphony of voices, identities, and diversifying worldviews are increasingly visible in the Finnish classrooms and confrontations between these create tensions also in and through the natural habitat of the youth, social media, which, with its algorithms, increases societal polarization and conflicts between identities and groups of people. However, the ability to coexist peacefully with people with diverging values and lifestyles without forcing anyone into certain societal norms and moulds is necessary to operate in a democratic society. Finnish youth share these thoughts and consider conflict resolution skills as important [40] and necessary in order to prevent hostile attitudes and radicalization [18].

Administered and promoted by governmental policies internationally and more recently also in Finland [42], the prevention of radicalization and violent extremism through education (PVE-E) has emerged as an important objective for educational institutions and, consequently, a novel field of study in the field of educational sciences. The aim of our research project [92] is to explore pedagogical vistas for carrying out PVE-E policies

in the context of Finnish formal education. This is a particularly topical issue at the moment when young people demonstrate active and democratic citizenship and agency by expressing their concerns, about e.g., climate change or the rights of minorities. It is, however, important to distinguish radicalization into extremism from radical thinking and radicalism, which refer to forward-looking patterns of thought and efforts to reform grievances or other perceived injustices in the mainstream society. The key is to differentiate between violent intentions or acts and peaceful pursuits of social change. Furthermore, in this perspective, it is necessary to strengthen the role of educational institutions in supporting young people to express and act upon their values in peaceful, democratic, and non-violent ways and to prevent them from turning into extremism.

The more media coverage is given to the signs of a world fraught with multiple insecurities and uncertainties, the more attention, we might argue, needs to be drawn in by teachers to the significance of knowledge processing and application. In order to prevent hostility and radicalization, students' minds need to stay as open as possible to new knowledge and perspectives [100]. In light of the findings of our studies [18,43,100], we argue that what schools can do to guide young students to positively and peacefully engage with each other and the society is to offer them a safe environment in which their awareness and understanding can be nurtured, and which gives them tools to assess and analyse the way societal and global phenomena and the (social) media affect their thoughts, emotions, and construction of beliefs, values, and identity. Teachers are important and central facilitators in these processes. Instead of controlling and limiting the topics of discussion, the aim of PVE-E should be to broaden and diversify the epistemic foundation of the students by letting them explore the depths of topics that at surface may seem sensitive, controversial, and potentially dangerous. However, it should be noted that these processes are enabled only by a teacher's self-reflection—the understanding of one's own epistemic foundation—in order to find ways to reduce its potentially harmful effects on the construction of worldviews and identities of the students.

In the development of pedagogical approaches for PVE-E, there is, we here suggest, an important role in understanding the views of the ultimate recipients of such teaching and learning approaches in schools: young people themselves. Our recently published theoretical framing of this issue has, additionally, taken into account the notional "threshold of adversity", those extreme circumstances and situations that push young people beyond the realm of safety into harm's way [100]. Our empirical study, the findings of which we presented here in specific reference to the views of young people in relation to education's role in the prevention of radicalization, makes a contribution to further such understanding of young people's views on these issues. This understanding, we hope, provides pathways to factor in approaches to such pedagogies. Indeed, members of our team have already made contributions to innovative counter-extremism in education policies in Finland. Continuing further to understand young people's views seems an obvious, but often missed, component of policy development in this area, the study of which remains for us ongoing, particularly as part of our 4-year research project *Growing up radical? The role of educational institutions in guiding young people's worldview construction*.

Author Contributions: Conceptualization, S.B., L.G. and A.K.; methodology, S.B. and P.K.; formal analysis, S.B. and V.S.; investigation, S.B. and P.K.; data curation, S.B. and V.S.; writing—original draft preparation, S.B. and L.G.; writing—review and editing, S.B., L.G. and A.K.; visualization, V.S.; supervision, A.K. and L.G.; funding acquisition, A.K., S.B., P.K. and L.G. Authorship must be limited to those who have contributed substantially to the work reported. All authors have read and agreed to the published version of the manuscript.

Funding: This study was carried out in the research project "Growing up radical? The role of educational institutions in guiding young people's worldview construction" funded by the Academy of Finland 2018-2022 (Grant 315860).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Humanities and social and

behavioural sciences at the University of Helsinki and the Departmental Research Ethics Committee at University of Oxford (DREC) (ED-CIA-19-108).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are openly available in the Finnish Social Science Data Archive https://www.fsd.tuni.fi/en/, accessed on 28 February 2021.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Nurmi, J.; Räsänen, P.; Oksanen, A. The norm of solidarity: Experiencing negative aspects of community life after a school shooting tragedy. *J. Soc. Work.* **2012**, *12*, 300–319. [CrossRef]
2. Parker, D.; Lindekilde, L.; Gøtzsche-Astrup, O. Recognising and responding to radicalisation at the 'frontline': Assessing the capability of school teachers to recognise and respond to radicalisation. *Br. Educ. Res. J.* **2021**. [CrossRef]
3. Stephens, W.; Sieckelinck, S.; Boutellier, H. Preventing Violent Extremism: A Review of the Literature. *Stud. Confl. Terror.* **2019**, *44*, 346–361. [CrossRef]
4. Niemi, P.-M.; Benjamin, S.; Kuusisto, A.; Gearon, L. How and Why Education Counters Ideological Extremism in Finland. *Religions* **2018**, *12*, 420. [CrossRef]
5. Sieckelinck, S.; Kaulingfreks, F.; De Winter, M. Neither Villains nor Victims: Towards an Educational Perspective on Radicalisation. *Br. J. Educ. Stud.* **2015**, *63*, 329–343. [CrossRef]
6. Noddings, N. *Peace Education. How We Come to Love and Hate War*; Cambridge University Press: New York, NY, USA, 2012.
7. Gereluk, D. *Education, Extremism and Terrorism. What Should Be Taught in Citizenship Education and Why*; Continuum International Publishing Group: Norfolk, Virginia, 2012.
8. García, J.A.R. Islamic religious education and the plan against violent radicalization in Spain. *Br. J. Relig. Educ.* **2019**, *41*, 412–421. [CrossRef]
9. Maddock, K. *British Values and the Prevent Duty in the Early Years. A Practitioner's Guide*; Jessica Kingsley Publishers: London, UK, 2017.
10. Bar-Tal, D.; Rosen, Y.; Nets-Zehngu, R. Peace Education in Societies Involved in Intractable Conflicts. In *Handbook on Peace Education*; Salomon, G., Cairns, E., Eds.; Routledge: Abingdon, UK, 2009.
11. Di Donato, D.; Grimi, E. (Eds.) *Metaphysics of Human Rights1948–2018. On the Occasion of the 70th Anniversary of the UDHR*; Vernon Press: New York, NY, USA, 2019.
12. Gearon, L. UNESCO Contemporary Issues in Human Rights Education. From Universal Declaration to World Programme: 1948–2008: 60 Years of Human Rights Education. 2011. pp. 39–104. Available online: http://unesdoc.unesco.org/images/0021/002108/210895e.pdf (accessed on 28 February 2021).
13. Gearon, L. Global Human Rights. In *The Palgrave International Handbook of Education for Citizenship and Social Justice*; Peterson, A., Hattam, R., Zembylas, M., Arthur, J., Eds.; Palgrave Macmillan: London, UK, 2016; pp. 205–228.
14. Gearon, L. Human Rights RIP: Critique and Possibilities for Human Rights Literacies. In *Human Rights Literacies: Future Directions*; Roux, C., Becker, A., Eds.; Springer: New York, NY, USA, 2019.
15. Gearon, L.; Kuusisto, A.; Musaio, M. The Origins and Ends of Human Rights Education: Enduring Problematics, 1948–2018. In *Metaphysics of Human Rights 1948–2018*; di Donato, L., Grimi, E., Eds.; Vernon Press: New York, NY, USA, 2019.
16. Gearon, L.; Kuusisto, A.; Matemba, Y.; Benjamin, S.; Du Preez, P.; Koirikivi, P.; Simmonds, S. Decolonising the Religious Education Curriculum: International Perspectives in Theory, Research, and Practice, Special Issue. *Br. J. Relig. Educ.* **2020**, *43*, 1–8. [CrossRef]
17. Lehtomäki, E.; Rajala, A. Global education research in Finland. In *The Bloomsbury Handbook of Global Education and Learning*; Bourn, D., Ed.; Bloomsbury Academic: London, UK, 2020; pp. 105–120.
18. Benjamin, S.; Koirikivi, P.; Kuusisto, A. Lukiolaisnuorten käsityksiä oppilaitosten roolista väkivaltaisen radikalisoitumisen ennaltaehkäisyssä. *Kasvatus* **2020**, *4*, 467–480.
19. Malkki, L. International Pressure to Perform: Counterterrorism Policy Development in Finland. *Stud. Confl. Terror.* **2016**, *39*, 342–362. [CrossRef]
20. Ghosh, R.; Chan, W.A.; Manuel, A.; Dilimulati, M. Can education counter violent religious extremism? *Can. Foreign Policy J.* **2016**, *23*, 117–133. [CrossRef]
21. OECD/PISA. Global Competence Framework. 2018. Available online: https://www.oecd.org/pisa/Handbook-PISA-2018-Global-Competence.pdf (accessed on 15 February 2021).
22. OSCE. Toledo Guiding Principles on Teaching about Religions and Beliefs in Public Schools. 2007. Available online: http://www.oslocoalition.org/documents/toledo_guidelines.pdf (accessed on 15 February 2021).
23. Riitaoja, A.-L.; Poulter, S.; Kuusisto, A. Worldviews and Multicultural Education in the Finnish Context: A Critical Philosophical Approach to Theory and Practices. *Finn. J. Ethn. Migr.* **2010**, *5*, 87–95. Available online: http://www.etmu.fi/fjem/ (accessed on 23 February 2021).
24. Poulter, S. Kansalaisena Maallistuneessa Maailmassa. Koulun Uskonnonopetuksen Yhteiskunnallisen Tehtävän Tarkastelua. Academic Dissertation, University of Helsinki, Helsinki, Finland, 2013.

25. Poulter, S.; Riitaoja, A.; Kuusisto, A. Thinking multicultural education 'otherwise'—From a secularist construction towards a plurality of epistemologies and worldviews. *Glob. Soc. Educ.* **2016**, *14*, 68–86. [CrossRef]
26. Kuusisto, A.; Poulter, S.; Harju-Luukkainen, H. Worldviews and national values in Swedish, Norwegian and Finnish early childhood education and Care curricula. *Int. Res. Early Child. Educ.*. in press.
27. Helve, H. A longitudinal perspective on worldviews, values and identities. *J. Relig. Educ.* **2015**, *63*, 95–115. [CrossRef]
28. Utriainen, T.; Ramstedt, T. Uushenkisyys. In *Monien Uskontojen ja Katsomusten Suomi*; Illman, R., Ketola, K., Latvio, R., Sohlberg, J., Eds.; Kirkon Tutkimuskeskuksen Verkkojulkaisuja, Nro 48, Kirkon Tutkimuskeskus: Tampere, Finland, 2017; pp. 213–223.
29. Cornelio, J.; Gauthier, F.; Martikainen, T.; Woodhead, L. (Eds.) *Routledge International Handbook of Religion in Global Society*; Routledge: Abingdon, UK, 2020.
30. Tirri, K. Finland—Promoting ethics and equality. In *Research for CULT Committee—Teaching Common Values in Europe: Study*; Structural and Cohesion Policies B; Veugelers, W., de Groot, I., Stolk, V., Eds.; European Parliament: Brussels, Belgium, 2017; pp. 83–90. [CrossRef]
31. NCCBE. National Core Curriculum for Basic Education. *Finnish National Agency for Education. Finnish Education in a Nutshell.* 2014. Available online: https://www.oph.fi/en/statistics-and-publications/publications/finnish-education-nutshell (accessed on 15 February 2021).
32. Statistics Finland. Immigrants in the Population. 2019. Available online: https://www.stat.fi/tup/maahanmuutto/maahanmuuttajat-vaestossa_en.html (accessed on 7 March 2021).
33. SUOL. Association of Teachers of Religious Education in Finland. Religious Education in Finland. 2019. Available online: https://www.suol.fi/index.php/religious-education-in-finland (accessed on 7 March 2021).
34. Ubani, M.; Hyvärinen, E.; Lemettinen, J.; Hirvonen, E. Dialogue, Worldview Inclusivity, and Intra-Religious Diversity: Addressing Diversity through Religious Education in the Finnish Basic Education Curriculum. *Religions* **2020**, *11*, 581. [CrossRef]
35. Åhs, V.; Poulter, S.; Kallioniemi, A. Preparing for the world of diverse worldviews: Parental and school stakeholder views on integrative worldview education in a Finnish context. *Br. J. Relig. Educ.* **2017**, *41*, 1–12. [CrossRef]
36. Statistics of Finland. Number of Members of the Evangelic Lutheran Church. 2019. Available online: https://www.stat.fi/tup/suoluk/suoluk_vaesto.html (accessed on 8 March 2021).
37. Lauritzen, S.M.; Nodeland, T.S. What happened and why? Considering the role of truth and memory in peace education curricula. *J. Curric. Stud.* **2017**, *49*, 437–455. [CrossRef]
38. Jerome, L.; Elwick, A. Teaching about terrorism, extremism and radicalisation: Some implications for controversial issues pedagogy. *Oxf. Rev. Educ.* **2020**, *46*, 222–237. [CrossRef]
39. Uusitalo, N.; Valaskivi, K. The Attention Apparatus: Conditions and Affordances of News Reporting in Hybrid Media Events of Terrorist Violence. *J. Pr.* **2020**, 1–19. [CrossRef]
40. Youth Barometer. 2018. Available online: https://tietoanuorista.fi/nuorisobarometri/nuorisobarometri-2018/ (accessed on 11 March 2021).
41. Youth Barometer. 2016. Available online: https://tietoanuorista.fi/nuorisobarometri/nuorisobarometri-2016/ (accessed on 11 March 2021).
42. Finnish Ministry of the Interior. National Action Plan for the Prevention of Violent Radicalisation and Extremism. 2020. Available online: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162073/SM_2020_1.pdf?sequence=4&isAllowed=y (accessed on 11 March 2021).
43. Koirikivi, P.; Benjamin, S.; Kuusisto, A.; Gearon, L. Youths' resilience and wellbeing in school-based prevention programs. An Investigation from the Finnish Context. In press.
44. Youth Barometer. 2019. Available online: https://tietoanuorista.fi/nuorisobarometri/nuorisobarometri-2019/ (accessed on 16 March 2021).
45. Statistics Finland. 2020. Available online: https://www.stat.fi/tietotrendit/artikkelit/2020/nuorten-rikollisuus-on-laskussa-mutta-pieni-joukko-nuorista-tekee-yha-enemman-ja-vakavampia-rikoksia/ (accessed on 11 March 2021).
46. Kotonen, T. The Soldiers of Odin Finland: From a local movement to an international franchise. In *Vigilantism against Migrants and Minorities, Routledge Studies in Fascism and the Far Right*; Bjørgo, T., Mareš, M., Eds.; Routledge: Abingdon, UK, 2019; pp. 241–256. [CrossRef]
47. Alava, S.; Frau-Meigs, D.; Hassan, G. *Youth and Violent Extremism on Social Media: Mapping the Research*; UNESCO: Paris, France, 2017.
48. Kuusisto, A.; Gearon, L. The Life Trajectory of the Finnish Religious Educator. *Relig. Educ.* **2017**, *44*, 39–53. [CrossRef]
49. Almond, B. Education for tolerance: Cultural difference and family values. *J. Moral Educ.* **2010**, *39*, 131–143. [CrossRef]
50. Davies, L. Security, extremism and education: Safe-guarding or surveillance? *Br. J. Educ. Stud.* **2016**, *64*, 1–19. [CrossRef]
51. Vallinkoski, K.; Benjamin, S.; Koirikivi, P. Prevention of Violent Radicalisation and Extremism in the Education Sector. In Finnish Ministry of the Interior. National Action Plan for the Prevention of Violent Radicalisation and Extremism 2019–2023. Publications of the Finnish Ministry of the Interior 2020, 3, pp. 74–81. Available online: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162200/SM_202... (accessed on 18 March 2021).
52. Grossman, M.; Hadfield, K.; Jefferies, P.; Gerrand, V.; Ungar, M. Youth Resilience to Violent Extremism: Development and Validation of the BRAVE Measure. *Terror. Politics Violence* **2020**, 1–21. [CrossRef]

53. Aly, A.; Taylor, E.; Karnovsky, S. Moral Disengagement and Building Resilience to Violent Extremism: An Education Intervention. *Stud. Confl. Terror.* **2014**, *37*, 369–385. [CrossRef]
54. European Commission. Prevent Strategies of Member States. 2020. Available online: https://ec.europa.eu/home-affairs/what-we-do/networks/radicalisation_awareness_network/ran-and-member-states/repository_en (accessed on 26 February 2021).
55. Nguyen, C.T. ECHO CHAMBERS AND EPISTEMIC BUBBLES. *Episteme* **2020**, *17*, 141–161. [CrossRef]
56. Allport, G.W. *The Nature of Prejudice*; Perseus Books: Cambridge, MA, USA, 1954.
57. UNESCO. Global Citizenship Education. Topics and Learning Objectives. 2015. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000232993 (accessed on 17 March 2021).
58. Brace, C.; Bailey, A.R.; Harvey, D.C. Religion, place and space: A framework for investigating historical geographies of religious identities and communities. *Prog. Hum. Geogr.* **2006**, *30*, 28–43. [CrossRef]
59. Stump, R. *The Geography of Religion: Faith, Place and Space*; Rowan & Littlefield: New York, NY, USA, 2008.
60. Côté-Lussier, C.; Fitzpatrick, C. Feelings of Safety at School, Socioemotional Functioning, and Classroom Engagement. *J. Adolesc. Health* **2016**, *58*, 543–550. [CrossRef]
61. Roux, C. (Ed.) *Safe Spaces: Human Rights Education in Diverse Contexts*; Sense Publications: Rotterdam, The Netherlands, 2014.
62. Gearon, L. Campus Conspiracies: Security and Intelligence Engagement with Universities from Kent State to Counter-Terrorism. *J. Beliefs Values* **2019**, *40*. [CrossRef]
63. Gearon, L. Securitisation Theory and the Securitised University: Europe and the Nascent Colonisation of Global Intellectual Capital. *Transform. High. Educ.* **2019**. [CrossRef]
64. Gearon, L. (Ed.) *The Routledge International Handbook of Universities, Security and Intelligence Studies*; Routledge: London, UK; New York, NY, USA, 2019.
65. Kuusisto, A. The Place of Religion in Early Childhood Education and Care. In *The Routledge International Handbook for the Place of Religion in Early Childhood Education and Care*; Kuusisto, A., Ed.; Routledge: Abingdon, UK, in press.
66. Sjøen, M.M.; Jore, S.H. Preventing extremism through education: Exploring impacts and implications of counter-radicalisation efforts. *J. Beliefs Values* **2019**, *40*, 269–283. [CrossRef]
67. Mattsson, C.; Säljö, R. Violent Extremism, National Security and Prevention. Institutional Discourses and their Implications for Schooling. *Br. J. Educ. Stud.* **2018**, *66*, 109–125. [CrossRef]
68. Ragazzi, F. *Students as Suspects? The Challenges of Developing Counter-Radicalisation Policies in Education in the Council of Europe Member States*; Interim Report; Council of Europe: Strasbourg, France, 2017.
69. Sian, K.P. Spies, surveillance and stakeouts: Monitoring Muslim moves in British state schools. *Race Ethn. Educ.* **2015**, *18*, 183–201. [CrossRef]
70. Mattsson, C.; Johansson, T. The hateful other: Neo-Nazis in school and teachers' strategies for handling racism. *Br. J. Sociol. Educ.* **2020**, *41*, 1149–1163. [CrossRef]
71. Rousseau, C.; Ellis, B.H.; Lantos, J.D. The Dilemma of Predicting Violent Radicalization. *Pediatrrics* **2017**, *140*, e20170685. [CrossRef]
72. Sivenbring, J. Democratic Dilemmas in Education against Violent Extremism. In *Policing Schools: School Violence and the Juridification of Youth*; Lunneblad, J., Ed.; Springer Nature Switzerland AG: Cham, Switzerland, 2019; pp. 173–186.
73. Faure-Walker, R. Teachers as informants: Countering extremism and promoting violence. *J. Beliefs Values* **2019**, *40*, 368–380. [CrossRef]
74. Busher, J.; Choudhury, T.; Thomas, P. The enactment of the counter-terrorism "Prevent duty" in British schools and colleges: Beyond reluctant accommodation or straightforward policy acceptance. *Crit. Stud. Terror.* **2018**, *12*, 440–462. [CrossRef]
75. Lorcerie, F.; Moignard, B. L'école, la laïcité et le virage sécuritaire post-attentats: Un tableau contrasté. *Sociologie* **2017**, *4*, 439–446. [CrossRef]
76. Van San, M.; Sieckelinck, S.; De Winter, M. Ideals adrift: An educational approach to radicalization. *Ethic Educ.* **2013**, *8*, 276–289. [CrossRef]
77. Flensner, K.K.; Von Der Lippe, M. Being safe from what and safe for whom? A critical discussion of the conceptual metaphor of 'safe space'. *Intercult. Educ.* **2018**, *30*, 275–288. [CrossRef]
78. Rom, R.B. 'Safe spaces': Reflections on an educational metaphor. *J. Curric. Stud.* **1998**, *30*, 397–408. [CrossRef]
79. Bhabha, H.K. *The Location of Culture*; Routledge: London, UK; New York, NY, USA, 1994.
80. Bhabha, H.K.; Ashcroft, B.; Beck, U.; Young, R.; Ikas, K.; Wagner, G. (Eds.) *Communicating in the Third Space*; Routledge: New York, NY, USA, 2009.
81. Kuusisto, A. Monikulttuurinen luokkahuone kolmantena tilana? *Kasvatus* **2020**, *51*, 204–214.
82. Cavanagh, T.; Macfarlane, A.; Glynn, T.; Macfarlane, S. Creating peaceful and effective schools through a culture of care. *Discourse Stud. Cult. Politicscs Educ.* **2012**, *33*, 443–455. [CrossRef]
83. Nasir, N.S.; Al-Amin, J. Creating Identity-Safe Spaces on College Campuses for Muslim Students. *Chang. Mag. High. Learn.* **2006**, *38*, 22–27. [CrossRef]
84. Weisse, W. REDCo: A European Research Project on Religion in Education. *Relig. Educ.* **2010**, *37*, 187–202. [CrossRef]
85. Hatzichristou, C.; Lianos, P.; Lampropoulou, A.; Stasinou, V. Individual and Systemic Factors Related to Safety and Relationships in Schools as Moderators of Adolescents' Subjective Well-Being During Unsettling Times. *Contemp. Sch. Psychol.* **2020**, *24*, 1–14. [CrossRef]

86. Williams, S.; Schneider, M.; Wornell, C.; Langhinrichsen-Rohling, J. Student's Perceptions of School Safety. *J. Sch. Nurs.* **2018**, *34*, 319–330. [CrossRef]
87. Ryan, R.; Deci, E. *Self-Determination Theory. Basic Psychological Needs in Motivation, Development and Wellness*; Guilford Press: New York, NY, USA, 2018.
88. Niemiec, C.P.; Ryan, R.M. Autonomy, Competence, and Relatedness in the Classroom: Applying Self-Determination Theory to Educational Practice. *Theory Res. Educ.* **2009**, *7*, 133–144. [CrossRef]
89. Findikaattori. 2021. Koulutukseen Hakeutuminen 2019. Available online: https://findikaattori.fi/fi/42 (accessed on 20 March 2021).
90. Kuusisto, A.; Poulter, S.; Kallioniemi, A. Finnish Pupils' Views on the Place of Religion in School. *Relig. Educ.* **2017**, *112*, 110–122. [CrossRef]
91. Virolainen, M.; Tønder, A.H. Progression to higher education from vocational education in Nordic countries: Mixed policies and pathways. In *Vocational Education in the Nordic Countries: Learning from Diversity*; Jørgensen, C.H., Olsen, O.J., Thunqvist, D.P., Eds.; Routledge: Oxon, UK, 2018; pp. 51–73.
92. Gearon, L. The Totalitarian Imagination: Religion, Politics and Education. In *International Handbook of Inter-Religious Education*; De Souza, M., Durka, G., Engebretson, K., Gearon, L., Eds.; Springer: Dordrecht, The Netherlands, 2010; pp. 933–947.
93. Tirri, K.; Kuusisto, E. Finnish student teachers' perceptions on the role of purpose in teaching. *J. Educ. Teach.* **2016**, *42*, 532–540. [CrossRef]
94. McGuire, J.K.; Clarke, T.J.; Anderson, C.R.; Russell, S.T. *Understanding School Safety for Transgender Youth. California Safe Schools Coalition Research Brief No. 13*; California Safe Schools Coalition: San Francisco, CA, USA, 2010.
95. McEvoy-Levy, S. Introduction. In *Peace and Resistance in Youth Cultures. Rethinking Peace and Conflict Studies*; Palgrave Macmillan: London, UK, 2018. [CrossRef]
96. Salomaa, H. Asevelvollisuus Kansakunnan Rakentajana. Politicsikasta-lehti. 4/2018. 2018. Available online: https://Politicsikasta.fi/asevelvollisuus-kansakunnan-rakentajana/ (accessed on 3 March 2021).
97. YLE. Survey: Young People's will to Defend Their Country Turned to Growth—Support for Universal Conscription also Rises Sharply. News Article in Finnish. 2020. Available online: https://yle.fi/uutiset/3-11179169 (accessed on 3 March 2021).
98. Maavoimat. Naisten Vapaaehtoiseen Asepalvelukseen Hakeneiden Määrä Kasvussa. 2020. Available online: https://maavoimat.fi/-/naisten-vapaaehtoiseen-asepalvelukseen-hakeneiden-maara-kasvussa (accessed on 3 March 2021).
99. Lehtonen, J. Going to the 'Men's School'? Non-heterosexual and trans youth choosing military service in Finland. *Norma* **2015**, *10*, 117–135. [CrossRef]
100. Benjamin, S.; Gearon, L.; Kuusisto, A.; Koirikivi, P. Threshold of Adversity: Resilience and the Prevention of Extremism through Education. *Nord. Stud. Educ.*. in press.
101. Davies, L. Education and violent extremism: Insights from complexity theory. *Educ. Confl. Rev.* **2019**, *2*, 76–80.
102. Vallinkoski, K.; Koirikivi, P.; Malkki, L. "What is this ISIS all about?" Addressing violent extremism with students: Finnish educators' perspectives. *Eur. Educ. Res. J.* **2021**. [CrossRef]
103. Besir, D.S.; Nuray, P. A Convergent Parallel Mixed-Methods Study of Controversial Issues in Social Studies Classes: A Clash of Ideologies. *Educ. Sci. Theory Pract.* **2018**, *18*, 119–149.
104. School Health Promotion Study. Finnish Institute for Health and Welfare. 2019. Available online: https://www.julkari.fi/handle/10024/140694 (accessed on 8 March 2021).
105. Feucht, F.C.; Brownlee, J.L.; Schraw, G. Moving Beyond Reflection: Reflexivity and Epistemic Cognition in Teaching and Teacher Education. *Educ. Psychol.* **2017**, *52*, 234–241. [CrossRef]
106. Maynes, J. Critical Thinking and Cognitive Bias. *Informal Log.* **2015**, *35*, 183–203. [CrossRef]
107. Tirri, K. Ethical Sensitivity in Teaching and Teacher Education. In *Encyclopedia of Teacher Education*; Peters, M., Ed.; Springer: Singapore, 2019. [CrossRef]
108. Findikaattori. 2020. Available online: https://findikaattori.fi/fi/57#:~{}:text=Pahoinpitelyj%C3%A4%20ilmoitettiin%20vuonna%202018%20yhteens%C3%A4,Niit%C3%A4%20ilmoitettiin%2023%20700 (accessed on 28 February 2021).

education sciences

MDPI

Article

What Kind of Feedback is Perceived as Encouraging by Finnish General Upper Secondary School Students?

Toni Mäkipää * and Raili Hildén

Faculty of Educational Sciences, University of Helsinki, 00014 Helsinki, Finland; raili.hilden@helsinki.fi
* Correspondence: toni.makipaa@helsinki.fi

Abstract: Our main aim in this study was to compare encouraging feedback practices in Finnish general upper secondary foreign language classes and examine how students perceive language teachers' assessment practices. The participants were 160 students of English, 95 students of Swedish, and 27 students of French from six general upper secondary schools. The data comprised one open-ended question and one Likert scale question with nine items. Both qualitative and quantitate methods were used to analyze the data. The results showed that content was the most important feature in feedback that was perceived as encouraging by students. The results further indicated that students considered teacher assessment practices to be primarily summative, but differences were also found between schools. The evidence from this study suggests that students appreciate teacher feedback, but do not perceive it to be an intrinsic part of teacher assessment practices. The importance of formative assessment and feedback should be more heavily emphasized in foreign language teacher education.

Keywords: feedback; formative assessment; general upper secondary education; Finland

Citation: Mäkipää, T.; Hildén, R. What Kind of Feedback is Perceived as Encouraging by Finnish General Upper Secondary School Students? *Educ. Sci.* **2021**, *11*, 12. https://doi.org/10.3390/educsci11010012

Received: 2 December 2020
Accepted: 28 December 2020
Published: 1 January 2021

1. Introduction

The major objective in this study was to discern what kind of feedback encourages Finnish general upper secondary school students in foreign language classes. More specifically, we compared students' perceptions of feedback in Swedish, English, and French languages classes. Moreover, we examined what language teachers' assessment practices encompass, according to students. The data comprised one open-ended question on examples of encouraging feedback practices and one Likert scale question with nine items in which the participants indicated what is included in teacher assessment practices in language classes.

The core curriculum for general upper secondary education [1] advocates the notion of student-centered learning: students are active in their learning process, and learning is considered to be a consequence of goal-oriented and self-directed actions. By giving constructive feedback, teachers enhance students' confidence and thinking. Moreover, all the teachers should provide their students with feedback during the learning process, and assessment and feedback constitute focal parts of teacher and student interactions. With regard to the general objectives of learning Swedish (as Finland's other national language) and foreign languages, students should develop their skills in using learning strategies, comprehend the meaning of multifaceted language proficiency, work actively to become goal-oriented language learners, and develop language awareness.

Swedish, English, and French are "different" subjects in Finnish schools. Swedish and English are mandatory subjects, and pupils usually start to study English before Swedish. More than 90 percent of Finnish-speaking students study the "A" syllabus in English, whereas most students study the "B" syllabus in Swedish and French. The number of students who participate in the English test in the matriculation examination is much higher than in the Swedish or French test [2]. Moreover, students' attitudes to English are more positive than to Swedish (see [3]).

Regarding assessment in general upper secondary education, it should be diverse and based on several issues. Teachers should use several assessment practices in their courses and one of the functions of assessment is to guide students in their learning process. In other words, assessment is not only about exams, essays, or other types of written work. Teachers should also take the formative aspect of assessment into account; namely, providing students with feedback and helping them discover their strengths and weaknesses. As a result, students learn more about themselves as learners [1]. Put differently, assessment should also guide students, not just grade them.

Feedback is a pivotal component of formative assessment, which is also referred to as assessment for learning. Giving feedback is an essential skill for teachers to have [4], and both the core curriculum for general upper secondary education [1] and the General Upper Secondary Schools Act [5] highlight the importance of feedback: teachers should give their students feedback in a range of ways. Moreover, feedback is a powerful tool for learning [6] as it also affects motivation and self-efficacy beliefs [7], and in this sense we all foster students' self-regulated learning [8]. All in all, feedback has a focal role in the learning process [9,10]. However, the quality of the feedback has a major effect on students in terms of whether the feedback encourages or discourages them [11]. Also, "many students are disengaged from the feedback process" [9] (p. 879), and students seem to receive less feedback on homework in higher grade levels (grades 5–12) [12]. Research on technology-enhanced feedback has stressed the importance of encouraging feedback as "pupils receiving mainly encouraging feedback reported the highest values indicating feedback as being beneficial for them" [13] (p. 10). Therefore, it is important to examine the perceptions of students about encouraging feedback in order to enhance assessment practices in education. Thus, our aim in this study was to investigate how the concept of teacher assessment practices differs between students and schools and the kinds of feedback Finnish general upper secondary school students find encouraging.

1.1. Assessment Is about Decisions

The traditional division between assessment types or strands tends to draw a somewhat simplistic border between summative and formative assessments, the first adhering to grading and selection and the latter to an ongoing process of promoting learning. Somewhere in between we find *diagnostic assessment*, a summary of previous learning outcomes and a starting point for a new track (e.g., [14,15]). However, the essence of assessment is neither its form nor its timing, but its consequences and impact that are mediated by the decisions based on assessment statements or test scores assigned to a particular performance [16]. While summative decisions of assessment may change the entire course of the life of a student or, in some highly test-driven contexts, even the fate of a teacher or a school, formative decisions are regarded as being less serious and more open-ended. Formative decisions pave the way for improved learning and often take the shape of advice, guidance, or recommendation instead of implementing a final conclusion that is difficult or impossible to change. Communicating formative assessment does not automatically exclude any reporting mode. The results of an instant small-scale classroom test can be reported in grades or scores, or in written or oral statements. All of these can be considered to be feedback to the student. Evaluative feedback can address a range of perspectives, such as effort and commitment to the task, strategies to carry out the task, the pace of completion, and the quality of the outcome in relation to resources. Corrective feedback can be either implicit or explicit, direct or indirect. In language teaching, implicit feedback encompasses conversational recasts, repetition, and clarification requests. Explicit correction can be given with or without metalinguistic explanation, didactic recast, elicitation, or various paralinguistic cues [17]. Feedback is a crucial tool in formative assessment [18,19] to guide and improve learning and it can take several forms and serve multiple functions.

In principle, feedback can be delivered by a teacher, peers, or the student him/herself, and at times, also by out-of-school collaborators or by automatic learning analytic devices. The nature of feedback can be conceptualized as input or as a dialogical process [20],

with the current mainstream trend focusing on the latter dimension. The evidence base of feedback ranges from work samples in oral, written, or multimedia forms to informal observations of the process of work individually or in groups [20,21]. Ultimately, the aim of feedback is to increase students' self-efficacy, self-regulation, and motivation for life-long learning [18,22].

1.2. Students' Perceptions of Feedback and Assessment

Many published studies have focused on students' perceptions of feedback and assessment. Prior research has substantiated the belief that students appreciate and value teacher feedback [23–25] and shown that students do not accept teachers not giving feedback at all [24]. Students find teacher feedback useful if they are aware of the learning goals and they exhibit high self-efficacy [26]. However, students do not seem to regard feedback as being as useful as their teachers do [27]. Moreover, students prefer comprehensive error treatment [24,28], as they do not find clues helpful [29]. Students want to get feedback on improvement [30] and teacher feedback should be tangible, honest, and critical [31]. Overall, students seem to be pleased with the quality of the feedback [27], although it has been reported in some studies that students find teacher feedback to be unclear (e.g., [10]). Additionally, students appreciate detailed and direct feedback [32]. However, overly detailed feedback can discourage students [33]. Students also want feedback during the learning process [34]. Regarding oral tasks, Martin and Alvarez Valdivia [25] found corrective feedback to be useful for learning but that students did not want to receive it too often. However, they found that more anxious students rated recast and metalinguistic feedback better.

Even though the number of studies focusing on students' perceptions about feedback has increased [35], far too little attention has been paid to the perceptions of general upper secondary school students of feedback or assessment in general in foreign languages in Finland. However, some studies have been conducted in recent years with students in basic or in general upper secondary education; Ilola [36] interviewed nine 9th grade English as a foreign language (EFL) students about their perceptions of the assessment of oral tasks. Based on the interviews, they pointed out that assessment and feedback enhance motivation and help students understand what needs to be improved. Nevertheless, students would like to have supportive feedback that states the strengths and weaknesses of the student instead of grades. Moreover, Pollari [37] studied the perceptions of 146 general upper secondary school EFL students with regard to how they had experienced assessment. The results indicated that most of the students were pleased with the assessment methods and felt that they took into account the knowledge and the skills of the students. However, it seems that teachers were more inclined to use summative methods, as one-third of the participants were not able to comment on the usefulness of formative assessment methods. The author concluded that the formative aspect of assessment should be emphasized more and assessment should be more diverse. Regarding empowerment, Pollari [38] studied what empowers and disempowers general upper secondary school EFL students. Based on survey answers from 146 students, assessment caused anxiety and stress for disempowered students who felt that they could not show what they were able to do in English with the assessment methods that teachers use. Instead, they would opt for more formative assessment. Regarding feedback, these students mentioned that they had not received enough feedback or that it had not helped them. In contrast, assessment was of more benefit to the nondisempowered students, who were more content with the assessment practices. However, the generalizability of these studies is problematic due to their sample sizes. Regarding the assessment practices in basic and general upper secondary education in Finland, Atjonen et al. [39] discovered that most of the assessment practices used by teachers are summative and noted that more attention should be paid to the enhancement of formative as well as interactive assessment practices. They also underscored that assessment should be used to guide students more. Similarly, Mäkipää and Ouakrim-Soivio [40] found that general upper secondary school teachers are prone to

using summative assessment methods and that students often report a lack of feedback during courses.

1.3. Language Learning, Motivation and Feedback

While a variety of definitions of the term *motivation* have been suggested, a precise definition has proved elusive. Although differences of opinion exist, there seems to be some agreement that motivation primarily concerns choice, persistence, and effort. Put differently, motivation explains why people do something, how long they do it, and how hard they pursue the goal [41] (p. 4). In a school context, feedback given by teachers enhances motivation [41,42], and particularly intrinsic motivation [42], which refers to actions executed due to genuine interest in something. By contrast, extrinsic motivation refers to actions executed to obtain something useful [43]. In their classic study, Gardner and Lambert [44] demonstrated that motivation has a substantial effect on second language learning. If students lack motivation, even excellent teaching does not accelerate learning [45].

Many published studies have described the relationship between teachers' feedback and students' motivation. Regarding writing, students perceive both positive and negative comments as being useful for learning and both types of comments also constitute a source of motivation [28]. Cauley and McMillan [46] underscored the notion of formative assessment and using informative comments. Feedback can encourage self-assessment or "influence how students attribute their successes" (p. 4). In contrast, normative feedback, which refers to comparing students, only increases motivation for extrinsic reasons. This view is supported by Dörnyei [47], who pointed out that teachers should regularly give feedback to their students on their progress, and by Murtagh [48], who underlined the importance of descriptive feedback instead of phatic and evaluative feedback. Regarding intrinsic motivation, "assessment practices that build on monitoring and scaffolding increase the motivation of students" [49] (p. 453). Moreover, the teacher's proximity helps when giving students feedback on their learning [49]. Similarly, Weurlander et al. [50] found that formative assessment can enhance intrinsic motivation in students, namely in students who have an interest in the subject at hand. However, they also found evidence for the effects of formative assessment on external motivation, namely in the pressure to study. Moreover, feedback and assessment can enhance students' motivation if they "are used for their intended purposes" [31] (p. 248).

1.4. Research Questions

As feedback constitutes an integral part of assessment and teaching, our aim in this paper is to compare encouraging feedback practices in Finnish general upper secondary foreign language classes and to examine how students perceive the concept of teachers' assessment practices. This paper is structured around three research questions:

1. How does the concept of teacher assessment practices differ between students studying English, Swedish, and French?
2. How does the concept of teacher assessment practices differ between students at average schools and reputable schools?
3. What kind of feedback do Finnish general upper secondary school students find encouraging?

"Feedback" here refers to teacher feedback to students, and "encouraging feedback" refers to feedback that students find inspiring and helpful. With regard to schools, "average schools" refers to schools with average-achieving students, whereas "reputable schools" refers to schools with high-achieving students.

2. Methodology

The data for this study were collected from 282 general upper secondary school students from six schools in several Finnish regions. Among the students, 95 were boys and 185 were girls. Two students did not indicate their gender. With regard to languages,

there were 160 students of English, 95 students of Swedish, and 27 students of French. The participants were aged 17 to 19 years and the necessary research permission for conducting research in schools was obtained. With regard to language choices, Finland is a bilingual country with two official languages: Finnish and Swedish. Students whose mother tongue is Finnish must study Swedish as a second national language and vice versa. Every student in the Finnish school system must study one compulsory syllabus in the second national language, Finnish or Swedish depending on one's mother tongue, and one advanced syllabus in a foreign language, which is customarily English. Students can also study optional languages, such as French, but it is not compulsory to choose a third language.

The students came from two types of school: average (n = 169) and reputable (n = 111). Two students did not indicate their school. The division was based on the grade point average (GPA) needed to enter the school. In reputable schools, the grade point averages were above nine (on a scale from four to ten), and in average schools they were between 7.3 and 7.5. The reputable schools in this study could even be called schools for the gifted: even though Finnish legislation does not recognize "gifted" education, it its extremely difficult to be accepted into these schools due to the high grade point average required. Moreover, one of these schools emphasizes foreign languages and could therefore be labeled as a special school, and it is also difficult to be accepted into these types of schools [51]. Moreover, it can be argued that differences in students' backgrounds can also be detected: students at reputable schools are more likely to come from wealthier families and districts. Swedish students came from three reputable and one average school, whereas English students came from two reputable and two average schools. French students came from one reputable and one average school.

Table 1 displays the previous course grades of the students in each language and by school. Eight students did not remember their previous grade.

Table 1. Means of the previous course grades by language and by school.

Language	Average Schools		Reputable Schools			All	
	M	S.D.	M	S.D.	p	M	S.D.
English	7.83	1.28	8.60	0.74	0.000 *	8.07	1.19
Swedish	7.70	1.54	8.26	1.16	0.047 *	8.02	1.36
French	8.84	0.83	9.25	1.04	0.290	8.96	0.90
All	7.91	1.35	8.48	1.02	0.000 *		

Note 1: M = mean, S.D. = standard deviation, * = $p < 0.05$. Note 2: Grades in Finnish schools range from four (failed) to ten (excellent).

As Table 1 shows, the means were always higher, for every comparison, in reputable schools, and statistically significant differences were present for English, Swedish, and between the schools. No difference was detected in French, probably due to the small sample size.

All the participants answered an online survey on feedback and assessment practices between November 2018 and September 2019. The survey was part of a wider study examining feedback practices in Finnish foreign language classes. The survey included closed-ended questions with a Likert scale (1 = strongly disagree, 5 = strongly agree) and one open-ended question. For this study, the answers to the open-ended question and one closed-ended question with nine items were analyzed. In the open-ended question, the students were asked to give examples of encouraging feedback practices. In the closed-ended question, there were nine assessment-related items, and the students rated whether these items were salient for teacher assessment practices. These items were based on the core curriculum and the different functions of assessment.

Data Analysis

The open-ended answers were analyzed using qualitative content analysis with an inductive approach. As we did not have specific expectations about the students' answers or of the categories that would emerge from the data, an inductive approach was used [52].

When qualitative data are divided into codes, the first step for the researcher is to become familiar with the data. Consequently, the researcher starts to notice patterns and connections [53]. The first author read through the data three times prior to coding the data using Atlas.ti. Coding refers to "the process of examining data, identifying and noting aspects that relate to your research questions". If all the data are analyzed, coding is *complete*, whereas if only some of the data are analyzed, coding is *selective* [54] (p. 328). As all the data were analyzed in this study, the coding was complete. Based on this definition, the unit of analysis was a single word, a sentence, or a combination of sentences expressing only one thought. As a result, 880 units were coded, and five main categories emerged from the analysis: content, nature, mode, process, and other issues. Subcategories were subsequently created to elaborate on the main categories. The second author agreed with the first author on the categories, how they were formed, and how the subcategories were created, which increases the reliability of this study.

Regarding content, all the units focusing on the content of an assignment, presentation, or another type of work, such as mistakes or how to improve the work, were grouped under "content", whereas units that described feedback with adjectives, such as clear or positive, were grouped under "nature". "Mode" referred to the form of the feedback whereas units describing the learning process in any way were grouped under "process". "Other issues" referred to issues that did not adhere to any of these categories.

The quantitative data were analyzed in SPSS version 25. One-way MANOVA was used to investigate what language teachers' assessment practices encapsulate according to English, Swedish, and French students. In turn, one-way ANOVA was used to compare the perceptions of students of average and reputable schools. If statistically significant differences occurred, post-hoc (Tukey) tests were also used.

3. Results

First, the quantitative results with regard to teachers' assessment practices are presented and discussed. Then, the qualitative results with regard to encouraging feedback practices are presented and discussed.

3.1. Teachers' Assessment Practices According to English, Swedish, and French Students

For the first research question, a one-way MANOVA was conducted to compare the means of the responses of English, Swedish, and French students regarding teachers' assessment practices in foreign languages. The question included nine items and the students evaluated whether they were important in teachers' assessment practices. The multivariate result was significant for language, Wilks' $\Lambda = 0.818$, $F = 3.083$, $df = 2$, $p = 0.000$, indicating a difference across languages. Table 2 presents the results of the analyses.

As shown in Table 2, Swedish students seemed to associate assessment primarily with grading exams (3.68) and giving course grades (3.60). Giving feedback (2.35) had the lowest mean. With regard to English students, they considered assessment to be primarily assessing essays (3.61) and other written tasks (3.61), as well as grading exams (3.52). Assessing oral skills had the lowest mean (2.48), and giving feedback had the second lowest mean (2.56). French students considered assessment primarily to be giving course grades (3.48), assessing essays (3.41), other written tasks (3.41), and exams (3.41), and enhancing learning (3.41). Assessing oral skills had the lowest mean (3.07), and giving feedback had the second lowest mean (3.15).

Table 2. Means of the responses of English, Swedish, and French students regarding teachers' assessment practices.

						99.9 % Confidence Interval	
Dependent Variable	**df**	**df Error**	**F**	**La**	**M**	**Lower Bound**	**Upper Bound**
Assessing essays	2	526	1.080 #	En	3.61	3.39	3.84
				Sw	3.48	3.17	3.79
				Fr	3.41	2.69	4.13
Assessing word tests	2	526	7.602 *	En	2.80	2.51	3.10
				Sw	3.30	2.96	3.63
				Fr	3.30	2.59	4.00
Assessing written work	2	526	1.329 #	En	3.61	3.35	3.86
				Sw	3.43	3.10	3.75
				Fr	3.41	2.74	4.07
Assessing oral work	2	526	3.824 *	En	2.48	2.19	2.77
				Sw	2.50	2.16	2.84
				Fr	3.07	2.19	3.96
Giving course grades	2	526	0.387 #	En	3.49	3.23	3.75
				Sw	3.60	3.27	3.93
				Fr	3.48	2.73	4.23
Assessing exams	2	526	1.189 #	En	3.52	3.24	3.79
				Sw	3.68	3.35	4.01
				Fr	3.41	2.71	4.10
Enhancing learning	2	526	3.710 *	En	2.97	2.69	3.26
				Sw	2.78	2.41	3.15
				Fr	3.41	2.56	4.25
Recognizing strengths	2	526	7.978 *	En	2.75	2.44	3.05
				Sw	2.44	2.07	2.80
				Fr	3.37	2.55	4.19
Giving feedback	2	526	6.083 *	En	2.56	2.28	2.85
				Sw	2.35	2.01	2.69
				Fr	3.15	2.23	4.07

Note 1: La = Language, En = English, Sw = Swedish, Fr = French. Note 2: * = $p < 0.05$, # = not significant.

Statistically significant differences were found for five items: assessing word tests ($p = 0.001$), assessing oral work ($p = 0.023$), enhancing learning ($p = 0.026$), recognizing strengths ($p = 0.000$), and giving feedback ($p = 0.003$). As the data were not evenly distributed, follow-up nonparametric Kruskal–Wallis tests were used to investigate the relationship between the perceptions of students and languages. The follow-up tests showed that there was no statistically significant difference in assessing oral work ($p = 0.070$). Consequently, this variable was excluded from the post hoc tests.

Post hoc comparisons using the Tukey test indicated that, with regard to word tests, differences were found between Swedish and English ($p = 0.001$). Regarding enhancing learning, differences were found between Swedish and French ($p = 0.021$). With regard to recognizing strengths, differences were found between Swedish and French ($p = 0.0000$) and between French and English ($p = 0.0018$). With regard to giving feedback, differences were found between Swedish and French ($p = 0.002$) and between French and English ($p. = 0.022$).

These results imply that students do not regard feedback to be an important part of teachers' assessment in foreign languages, as it had the lowest mean among Swedish students, and the second lowest among both English and French students. Assessing oral work, in turn, had the lowest mean among French and English students, and the third lowest among Swedish students.

3.2. The Concept of Teachers' Assessment Practices in Different Schools

Regarding the second research question, a one-way ANOVA was conducted to compare the students' perceptions of teacher assessment practices in both types of school. The differences between the schools are highlighted in Table 3.

Table 3. Perceptions of teachers' assessment practices in general upper secondary schools.

Variables	Average Schools		Reputable Schools						
	M	S.D.	M	S.D.	df	MS	F	p	η^2
Assessing essays	3.55	0.89	3.54	0.87	1	0.012	0.016	0.901	0.00
Assessing word tests	3.00	1.12	3.06	0.99	1	0.198	0.174	0.677	0.00
Assessing written work	3.55	0.94	3.50	0.95	1	0.186	0.209	0.648	0.00
Assessing oral work	2.63	1.09	2.41	1.02	1	3.207	2.854	0.092	0.01
Giving course grades	3.59	0.92	3.43	1.00	1	1.556	1.711	0.192	0.01
Assessing exams	3.62	0.95	3.48	1.03	1	1.261	1.305	0.254	0.01
Enhancing learning	3.05	1.06	2.80	1.11	1	4.315	3.700	0.055	0.01
Recognizing strengths	2.83	1.10	2.52	1.12	1	6.145	5.009	0.026 *	0.02
Giving feedback	2.70	1.04	2.34	1.07	1	8.283	7.453	0.007 *	0.03

Note 1: M = mean, S.D. = standard deviation, MS = mean squares, * = $p < 0.05$, η^2 = partial eta squared.

As we can see from Table 3, assessment was primarily perceived as assessing essays (3.62) and giving course grades (3.59), according to students from average schools. Giving feedback (2.70) had the lowest mean. In contrast, students from reputable schools associated assessment primarily with assessing essays (3.54) and assessing written work (3.50). Giving feedback (2.43) again had the lowest mean. The students from average schools had a higher mean in eight variables. The students at reputable schools had a higher mean only in assessing word tests.

A comparison of the two types of school reveals that assessing essays, written work, and exams, as well as giving course grades, were rated quite highly by students from both school types. In contrast, giving feedback, assessing oral work, and recognizing students' strengths were rated low. However, two statistically significant differences were found between the schools: students at average schools rated giving feedback (p = 0.007) and recognizing students' strengths (p =0.026) higher than students at reputable schools. As the data were not evenly distributed, follow-up nonparametric Mann–Whitney U tests were used to examine the relationship between the perceptions of students and schools. The test revealed the same two variables with statistically significant differences.

To sum up the results, the content of the feedback was the most important feature in encouraging feedback for each language. Regarding the concept of assessment, it was primarily perceived to be about grading exams and course grades; in other words, summative assessment. The notion of feedback had an extremely low mean among English and Swedish students, whereas French students regarded feedback to be a salient part of assessment. In addition, students at average and reputable schools associated teacher assessment practices with exams and course grades especially. However, students at average schools were also more inclined to associate feedback and the learning process with assessment.

3.3. Encouraging Feedback Practices According to Students

The aim of the third research question was to investigate encouraging feedback practices in language classes in general upper secondary schools. Among the answers, five issues were mentioned by only one student and these were excluded from the table. Table 4 presents the results obtained from the content analysis.

Table 4. Encouraging feedback practices according to general upper secondary school students.

		English		Swedish		French	
Categories	**Subcategories**	%	N	%	N	%	N
Content		**51**	**209**	**47**	**131**	**55**	**51**
	Mistakes	15	60	17	47	10	9
	Cons	5	21	4	11	4	4
	Pros	15	62	11	31	18	17
	What to improve	12	51	11	31	13	12
	Tangible tips	3	12	3	9	8	7
	Where student has improved	1	3	1	2	-	-
	Spelling	-	-	-	-	2	2
Nature		**33**	**138**	**32**	**89**	**29**	**27**
	Differentiated	1	3	3	8	1	1
	Critical	13	55	9	25	11	10
	Positive	13	54	14	39	11	10
	Clear and unambiguous	6	26	6	17	7	6
Mode		**9**	**39**	**12**	**34**	**7**	**6**
	Written	5	21	5	15	2	2
	Oral	2	7	3	9	3	3
	Individual	3	11	3	7	1	1
	In/after class	-	-	1	3	-	-
Process		**5**	**21**	**6**	**15**	**9**	**8**
	How to change learning	1	5	2	5	2	2
	How to enhance skills	3	11	3	9	7	6
	Mid-term assessment	0	1	0	1	-	-
	How to affect course grade	1	2	-	-	-	-
	Continuous feedback during the course	1	2	-	-	-	-
Other Issues		**2**	**7**	**3**	**9**	**0**	**0**
	Dissatisfaction with current fb practices	1	2	1	2	-	-
	Fb does not motivate	0	1	1	2	-	-
	I do not know	0	1	1	2	-	-
	All fb helps	-	-	1	2	-	-
	Scoring	1	3	0	1	-	-
TOTAL		**100**	**414**	**100**	**278**	**100**	**92**

Note 1. N = number of participants raising the issue, - = data not obtained, Fb = feedback. Note 2: The numbers are rounded up. Note 3: Issues mentioned by only one student were excluded from the table.

To illustrate the main categories, examples of students' answers for each category are provided.

1. Nature: "Feedback that has been clearly stated." (English)
2. Process: "(The teacher) explains... how I could improve my studying." (English)
3. Content: "(The teacher) corrects the grammar mistakes." (French)
4. Mode: "Oral... feedback after for instance a writing assignment." (Swedish)
5. Other issues: "Teachers do not give enough feedback if writing and speaking are fluent." (English)

As portrayed in Table 4, the content of the feedback was the category mentioned most often for English students, with 50% of the answers focused on it. The second most mentioned category was the nature of the feedback (33%), followed by the mode (9%), the learning process (5%), and other issues (2%). Similarly, Swedish students referred to content most often (47%), followed by the nature of feedback (32%), the mode (12%), the learning process (5%), and other issues (3%). In contrast, the answers of French students differed slightly. The content (55%) was the most mentioned category, followed by the nature of feedback (29%), the learning process (9%), and the mode (7%).

A comparison of the languages reveals several noteworthy differences. First, the content of feedback was the most often mentioned category in encouraging feedback in each language, followed by the nature of feedback. Second, the third most often mentioned category was the mode for Swedish and English students, whereas for French students it was the process. Third, feedback on spelling was only mentioned by two French students. Fourth, both English and French students were unanimous about the importance of critical and positive feedback in the quality of feedback. In contrast, Swedish students heavily emphasized positive feedback over critical feedback. Fifth, feedback on the learning process was in turn mentioned more by the French students than by English or Swedish students. Sixth, only Swedish students addressed feedback both in lessons and after them and stated that all feedback motivated them. Moreover, only English students stated that they wanted feedback continuously in courses and that they wanted feedback on how to affect the course grade. Finally, French students did not mention mid-term assessment, which was mentioned by both English and Swedish students.

4. Discussion

The findings from this study reveal several salient aspects of feedback practices in language classes. With regard to previous research, the results are consistent with several studies: students want to receive feedback on how to improve their work [30], teacher feedback should be tangible and critical [31], and students want to receive feedback on their errors [24,28]. As students want to improve their work with teacher feedback, it can be concluded that they also appreciate teacher feedback [23–25]. In contrast to earlier findings, however, students in this study did not particularly want to receive feedback on the learning process [34]. Nevertheless, it is apparent that the French students found feedback on the learning process more encouraging than the Swedish or English students. Similarly, the quantitative results show that the French students perceived teachers' assessments to be more relevant to the learning process than their English and Swedish peers. A probable explanation is that the French students were a select group of students who were genuinely interested in learning languages and possessed the skills and strategies needed to successfully learn them, as French is an optional language at Finnish schools. Put differently, students who struggle with languages or have learning difficulties do not usually choose an optional language. Moreover, this result can be explained by the fact that teachers use different teaching methods in French lessons compared to Swedish or English lessons; for instance, French teachers encourage their students to use French in their spare time more than English or Swedish teachers [55].

Another notable observation from the data is that Swedish students, compared to English and French students, clearly preferred positive to critical feedback. One reason for this could be that students are generally weak in Swedish and have a negative attitude to it [56]. Thus, students might hope for positive feedback to encourage them. However, Brookhart [4] has argued that constructive criticism is welcomed in the classroom.

Swedish students tend to associate teachers' assessments heavily with assessing exams and giving course grades; in other words, with somewhat typical forms of assessment in teaching. Interestingly, the mean for giving feedback was the lowest in Swedish. A previous study [56] discovered that many Swedish teachers do not give feedback to pairs, groups, or the whole class during lessons. Consequently, Swedish students might be accustomed to not receiving feedback from Swedish teachers, which is extremely alarming. A lack of feedback means that students are not aware of their weaknesses and what they should improve [57].

As the core curriculum [1] stipulates that teachers should give feedback to their students, one unanticipated finding was that students do not perceive feedback to be an essential part of language teachers' assessment practices. One Swedish student even wrote that he or she had never received feedback from Swedish teachers in basic or general upper secondary school. This observation is in agreement with Baran-Lucarz [58], who found that some students claim not to have received feedback at all from teachers. Even if this remark

can be subject to criticism, it raises an interesting question of whether students notice teachers' feedback (see [40]), since formative assessment is not as apparent as summative assessment [57]. As feedback should be a dialog between a student and a teacher [59], we suggest that teachers should make their feedback practices clearer to students and engage students in discussions on the feedback.

With regard to schools, feedback seems to be a more apparent form of assessment for students from average schools. We speculate that this might be due to the differences in the school cultures: teachers in reputable schools might think that students already possess the capabilities needed to acquire the skills and abilities for self-regulated learning. The students at reputable schools also had better previous course grades. As a result, teachers might not necessarily perceive feedback and the learning process to be so vital for the assessment. These insights, albeit tentative, are alarming, as students at reputable schools do not necessarily get better results in the matriculation examination than students at other schools [60]. However, feedback is a requirement for effective assessment and students need feedback during the learning process [18]. There is also some evidence that suggests that Finnish students would like to get more feedback during the learning process [34]. Taking these findings into account, we argue that foreign language teachers should pay more attention to the learning process of their students and ensure that they provide feedback on it. Moreover, especially in reputable schools, teachers should critically reflect on their assessment practices and ponder whether they take the learning process into account in their assessment practices and give enough feedback to students.

As the quantitative results demonstrate, feedback is not regarded to be a vital component in the concept of teachers' assessment practices. One plausible explanation for this might be "generally low levels of student feedback literacy". This term can be conceptualized as the understanding of what feedback means and how it can be used [61] (p. 1316). If students lack the knowledge of what feedback refers to and how it can be used to accelerate learning, it is not so surprising that they do not associate it with teachers' assessment practices. Especially since teachers' formative assessment practices help students take control over their learning [62], it is instrumental for students to understand the value of feedback. Similarly, students should understand the distinct functions of assessment to advance in their studying and become self-regulated learners [63], which is also one of the objectives of the core curriculum [1]. One of the issues that emerges from these findings is that more attention should be paid to the advancement of student feedback literacy, which would enable students to understand how assessment advances their learning.

Contrary to expectations, none of the students mentioned technology-enhanced feedback as a source of encouraging feedback, which contrasts with Oinas et al. [13] who found that several teachers tried to encourage students with technology-enhanced feedback, although these authors studied basic education. The matriculation examination is completely electronic in Finland and course books are available both in print and electronic versions. Therefore, laptops and online platforms are a common feature of Finnish general upper secondary schools, meaning that one would assume that at least some students would mention technology-enhanced feedback. However, some studies have demonstrated that teachers do not use technology for formative assessment [64] and that teachers face some challenges in implementing formative assessment practices, such as class size and lack of competencies [65]. Another unanticipated finding was that few students wanted individual feedback. If teachers want to support the engagement of students, on-going dialogue between students and teachers is needed [59], which is easy to achieve in individual feedback. However, students scarcely ever engage with the feedback processes [66]. Therefore, more emphasis should be put on how to improve students' engagement with teachers' feedback practices. Additionally, the French students did not consider *assessing oral work* to be an essential part of teachers' assessment practices, which is surprising as French students do not exhibit high proficiency in speaking French [67].

With regard to language teacher education, the results in this study indicate that more emphasis should be placed on the importance of formative assessment and feed-

back in assessment courses, thereby helping teacher students understand how feedback guides and accelerates students' learning. Studies have shown that research-based instruction can modify student teachers' conceptions of assessment [68,69]; thus, this type of instruction could be used in assessment courses. Furthermore, international research has established that many teachers exhibit insufficient knowledge of formative assessment practices (e.g., [70,71]). Therefore, student teachers should be given more opportunities to practice how to give feedback to students to enhance their knowledge of formative assessment and feedback since teacher education plays a pivotal role in enhancing student teachers' knowledge of assessment [68].

Finally, several potential shortfalls of this study need to be considered. First, the participants were not randomly chosen for this study and many of them came from the metropolitan area of Helsinki. Second, the number of students for each language varied and, ideally, the number of students could have been more evenly distributed across genders. Third, due to the small sample size, the results are not generalizable and the results regarding French students are especially tentative. Fourth, the sample size could have been expanded by including more students from other parts of Finland. Notwithstanding the limitations mentioned above, this study constitutes an excellent initial step toward enhancing feedback practices in foreign language classes in Finnish general upper secondary schools.

5. Conclusions

The following conclusions can be drawn from the present study: students appreciate teacher feedback and they particularly want to receive feedback on the content of the work. Regarding teacher assessment practices, students do not perceive feedback to be a crucial part of them. However, students at average schools find feedback to be a more important part of teacher assessment practices than students at reputable schools. The importance of feedback and formative assessment should also be underscored more in language teacher education. Moreover, there is abundant room for further progress in elucidating what encouraging feedback means for students at different proficiency levels and whether gender affects students' perceptions of encouraging feedback. Personal interviews could also elicit greater information concerning encouraging feedback in foreign language teaching. Moreover, further research is required to establish the relationship between diverse feedback and assessment practices in schools. As this study focused only on teachers' feedback, more research is needed to assess encouraging feedback in peer feedback.

Author Contributions: Conceptualization, T.M.; methodology, T.M.; software, not applicable.; validation, T.M.; formal analysis, T.M.; investigation, T.M.; resources, not applicable; data curation, T.M.; writing—original draft preparation, T.M. and R.H.; writing—review and editing, T.M. and R.H.; visualization, T.M.; supervision, R.H.; project administration, T.M.; funding acquisition, T.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was partially funded by the Swedish Cultural Foundation in Finland.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are not publicly available due to the fact that the data can only be used in Toni Mäkipää's PhD studies.

Acknowledgments: We would like to thank the anonymous reviewers for their insightful comments and the students for participating in this study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. FNBE. *National Core Curriculum for General Upper Secondary Schools 2015*; Finnish National Board of Education: Helsinki, Finland, 2016; Available online: https://www.ellibslibrary.com/book/9789521362675 (accessed on 4 November 2020).
2. Matriculation Examination Board. 2020. Available online: https://www.ylioppilastutkinto.fi/ext/stat/FS2020A2011T2010.pdf (accessed on 25 November 2020).

3. Mäkipää, T. Feedback practices in language classes in Finnish general upper secondary schools. *Apples. J. Appl. Lang. Stud.* **2020**, *14*, 103–123. [CrossRef]
4. Brookhart, S.M. *How to Give Effective Feedback to Your Students*, 2nd ed.; ASCD: Alexandria, VA, USA, 2017.
5. General Upper Secondary Schools Act, 714/2018. Available online: https://www.finlex.fi/fi/laki/ajantasa/2018/20180714 (accessed on 4 November 2020).
6. Furtak, E.M.; Kiemer, K.; Circi, R.K.; Swanson, R.; de León, V.; Morrison, D.; Heredia, S.C. Teachers' formative assessment abilities and their relationship to student learning: Findings from a four-year intervention study. *Instr. Sci* **2016**, *44*, 267–291. [CrossRef]
7. Heritage, M. Formative Assessment: What Do Teachers Need to Know and Do? *Phi Delta Kappan.* **2007**, *89*, 140–145. [CrossRef]
8. Xiao, Y.; Yang, M. Formative assessment and self-regulated learning: How formative assessment supports students' self-regulation in English language learning. *System* **2019**, *81*, 39–49. [CrossRef]
9. Price, M.; Handley, K.; Millar, J. Feedback: Focusing on engagement. *Stud. High. Educ.* **2011**, *36*, 879–896. [CrossRef]
10. Weaver, M.R. Do students value feedback? Student perceptions of tutors' written responses. *Assess. Eval. High. Educ.* **2006**, *31*, 379–394. [CrossRef]
11. Doan, L. Is Feedback a Waste of Time? The Students' Perspective. *J. Pers. Appl. Acad. Pract.* **2013**, *1*, 3–10. [CrossRef]
12. Núñez, J.C.; Suárez, N.; Rosário, P.; Vallejo, G.; Cerezo, R.; Valle, A. Teachers' Feedback on Homework, Homework-Related Behaviors, and Academic Achievement. *J. Educ. Res.* **2015**, *108*, 204–216. [CrossRef]
13. Oinas, S.E.; Thuneberg, H.; Vainikainen, M.-P.; Hotulainen, R. Technology-enhanced Feedback Profiles and their Associations with Learning and Academic Well-being Indicators in Basic Education. *Contemp. Educ. Technol.* **2020**, *12*, 1–15. [CrossRef]
14. Vogt, K.; Tsagari, D. Assessment literacy of foreign language teachers: Findings of a European study. *Lang. Assess. Q.* **2014**, *11*, 374–402. [CrossRef]
15. Huhta, A.; Hildén, R. (Eds.) *Kielitaidon Arviointitutkimus 2000-Luvun Suomessa*; Finnish Association of Applied Linguistics: Jyväskylä, Finland, 2016.
16. Bachman, L.; Damböck, B. *Language Assessment for Classroom Teachers*; Oxford University Press: Oxford, UK, 2018.
17. Sheen, Y.; Ellis, R. Corrective feedback in language teaching. In *Handbook of Research in Second Language Teaching and Learning*; Hinkel, E., Ed.; Routledge: New York, NY, USA, 2011; Volume II, pp. 593–610.
18. Hattie, J.; Timperley, H. The Power of Feedback. *Rev. Educ. Res.* **2007**, *77*, 81–112. [CrossRef]
19. Black, P.; Wiliam, D. Classroom Assessment and Pedagogy. *Assess. Educ.* **2018**, *25*, 551–575. [CrossRef]
20. Ajjawi, R.; Boud, D. Researching feedback dialogue: An interactional analysis approach. *Assess. Eval. High. Educ.* **2017**, *42*, 252–265. [CrossRef]
21. Ellis, R.; Shintani, N. *Exploring Language Pedagogy through Second Language Acquisition Research*; Routledge: Abingdon, UK, 2014.
22. Bandura, A. (Ed.) *Self-Efficacy in Changing Societies*; Cambridge University Press: Cambridge, UK, 1995.
23. Jakobson, L. Holistic perspective on Feedback for adult beginners in an online course of Swedish. *Apples. J. Appl. Lang. Stud.* **2015**, *9*, 51–71. [CrossRef]
24. McMartin-Miller, C. How much feedback is enough? Instructor practices and student attitudes toward error treatment in second language writing. *Assess. Writ.* **2014**, *19*, 24–35. [CrossRef]
25. Martin, S.; Alvarez Valdivia, I.B. Students' feedback beliefs and anxiety in online foreign language oral tasks. *Int. J. Educ. Technol. High. Educ.* **2017**, *14*, 1–15. [CrossRef]
26. Vattoy, K.-D.; Smith, K. Students' perceptions of teachers' feedback practice in teaching English as a foreign language. *Teach. Teach. Educ.* **2019**, *85*, 260–268. [CrossRef]
27. van der Kleij, F.M. Comparison of teacher and student perceptions of formative assessment feedback practices and association with individual student characteristics. *Teach. Teach. Educ.* **2019**, *85*, 175–189. [CrossRef]
28. Tom, A.A.; Morni, A.; Metom, L.; Joe, S. Students' Perception and Preferences of Written Feedback in Academic Writing. *Mediterr. J. Soc. Sci.* **2013**, *4*, 72–80. [CrossRef]
29. Amrhein, H.R.; Nassaji, H. Written Corrective Feedback: What Do Students and Teachers Prefer and Why? *Can. J. Appl. Linguist.* **2010**, *13*, 95–127.
30. Brooks, C.; Huang, Y.; Hattie, J.; Carroll, A.; Burton, R. What Is My Next Step? School Students' Perceptions of Feedback. *Front. Educ.* **2019**, *96*, 1–14. [CrossRef]
31. Peterson, E.R.; Irving, S.E. Secondary school students' conceptions of assessment and feedback. *Learn. Instr.* **2008**, *18*, 238–250. [CrossRef]
32. Elwood, J.A.; Bode, J. Student preferences vis-à-vis teacher feedback in university EFL writing classes in Japan. *System* **2014**, *42*, 333–343. [CrossRef]
33. Hedgcock, J.; Lefkowitz, N. Some Input on Input: Two Analyses of Student Response to Expert Feedback in L2 Writing. *Mod. Lang. J.* **1996**, *80*, 287–308. [CrossRef]
34. Pollari, P. To feed back or to feed forward? Students' experiences of and responses to feedback in a Finnish EFL classroom. *Apples. J. Appl. Lang. Stud.* **2017**, *11*, 11–33. [CrossRef]
35. Vattoy, K.-D. Teachers' beliefs about feedback practice as related to student self-regulation, self-efficacy, and language skills in teaching English as a foreign language. *Stud. Educ. Eval.* **2020**, *64*, 1–12. [CrossRef]

36. Ilola, M. Oppilaiden käsityksiä englannin suullisesta kielitaidosta—Suuntaviivoja suullisen kielitaidon opetukseen ja arviointiin. In *Kielididaktiikan Katse Tulevaisuuteen: Haasteita, Mahdollisuuksia Ja Uusia Avauksia Kielten Opetukseen*; Hildén, R., Hahl, K., Eds.; Suomen ainedidaktisen tutkimusseuran julkaisuja, Ainedidaktisia tutkimuksia 17: Helsinki, Finland, 2020; pp. 129–151.
37. Pollari, P. "Mitä pitäisi kehittää ja miten?" Lukiolaisten kokemuksia arvioinnista ja sen menetelmistä englannin opinnoissa. In *Kielididaktiikan Katse Tulevaisuuteen: Haasteita, Mahdollisuuksia Ja Uusia Avauksia Kielten Opetukseen*; Hildén, R., Hahl, K., Eds.; Suomen ainedidaktisen tutkimusseuran julkaisuja, Ainedidaktisia tutkimuksia 17: Helsinki, Finland, 2020; pp. 153–171.
38. Pollari, P. The power of assessment: What (dis)empowers students in their EFL assessment in a Finnish upper secondary school? *Apples. J. Appl. Lang. Stud.* **2017**, *11*, 147–175. [CrossRef]
39. Atjonen, P.; Laivamaa, H.; Levonen, A.; Orell, S.; Saari, M.; Sulonen, K.; Tamm, M.; Kamppi, P.; Rumpu, N.; Hietala, R.; et al. *"Että Tietää Missä on Menossa" Oppimisen ja Osaamisen Arviointi Perusopetuksessa ja Lukiokoulutuksessa*; Publications of the Finnish Education Evaluation Centre (FINEEC): Tampere, Finland, 2019; Available online: https://karvi.fi/app/uploads/2019/04/KARVI_0719.pdf (accessed on 31 August 2020).
40. Mäkipää, T.; Ouakrim-Soivio, N. Perceptions of Finnish Upper Secondary School Students of the Assessment Practices of Their Teachers. *J. Teach. Learn.* **2019**, *13*, 23–42. [CrossRef]
41. Dörnyei, Z.; Ushioda, E. *Teaching and Researching Motivation*, 2nd ed.; Routledge: New York, NY, USA, 2011.
42. Ryan, R.M.; Deci, E.L. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* **2000**, *55*, 68–78. [CrossRef]
43. Ryan, R.M.; Deci, E.L. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemp. Educ. Psychol.* **2000**, *25*, 54–67. [CrossRef]
44. Gardner, R.C.; Lambert, W.E. Motivational variables in second-language acquisition. *Can. J. Psychol.* **1959**, *13*, 266–272. [CrossRef]
45. Dörnyei, Z. *The Psychology of the Language Learner. Individual Differences in Second Language Acquisition*; Routledge: New Jersey, NJ, USA, 2005.
46. Cauley, K.M.; McMillan, J.H. Formative Assessment Techniques to Support Student Motivation and Achievement. *Clear. House* **2010**, *83*, 1–6. [CrossRef]
47. Dörnyei, Z. *Motivational Strategies in the Language Classroom*; Cambridge University Press: Cambridge, UK, 2001.
48. Murtagh, L. The motivational paradox of feedback: Teacher and student perceptions. *Curric. J.* **2014**, *25*, 516–541. [CrossRef]
49. Pat-El, R.; Harm, T.; van Koppen, S.W.M. Effects of formative feedback on intrinsic motivation: Examining ethnic differences. *Learn. Individ. Differ.* **2012**, *22*, 449–454. [CrossRef]
50. Weurlander, M.; Söderberg, M.; Scheja, M.; Hult, H.; Wernerson, A. Exploring formative assessment as a tool for learning: Students' experiences of different methods of formative assessment. *Assess. Eval. High Educ.* **2012**, *37*, 747–760. [CrossRef]
51. Tirri, K.; Kuusisto, E. How Finland Serves Gifted and Talented Pupils. *J. Educ. Gift.* **2013**, *36*, 84–96. [CrossRef]
52. Mayring, P. Qualitative Content Analysis (28 paragraphs). *Forum Qual. Soc. Res.* **2000**, *1*, 20.
53. Drisko, J.; Maschi, T. *Content Analysis*; Oxford University Press: New York, NY, USA, 2015. [CrossRef]
54. Brown, V.; Clarke, V. *Successful Qualitative Research: A Practical Guide for Beginners*; Sage: Los Angeles, CA, USA, 2013.
55. Härmälä, M.; Hildén, R.; Leontjev, D. Yhdeksäsluokkalaisten opiskelukäytänteet englannin, ruotsin ja ranskan oppitunneilla [The study practices of 9th graders in English, Swedish, and French lessons and spare time]. In *In Kielitaidon arviointitutkimus 2000-luvun Suomessa [Research on Language Assessment in the 21st Century Finland]*; Huhta, A., Hildén, R., Eds.; Finnish Association of Applied Linguistics: Jyväskylä, Finland, 2016; pp. 142–166.
56. Tuokko, E. *Miten ruotsia osataan peruskoulussa? Perusopetuksen päättövaiheen ruotsin kielen B-oppimäärän oppimistulosten kansallinen arviointi 2008 [How is Swedish mastered in basic education? National evaluation of the learning outcomes in B level Swedish after basic education 2008]*; Finnish National Agency for Education: Helsinki, Finland, 2009.
57. Ketabi, S.; Ketabi, S. Classroom and Formative Assessment in Second/Foreign Language Teaching and Learning. *Theory. Pract. Lang. Stud.* **2014**, *4*, 435–440. [CrossRef]
58. Baran-Lucarz, M. Formative assessment in the English as a foreign language classroom in secondary schools in Poland. Report on a mixed-method study. *J. Educ. Cult. Soc.* **2019**, *10*, 309–327. [CrossRef]
59. Pryor, P.; Crossouard, B. A socio-cultural theorisation of formative assessment. *Oxf. Rev. Educ.* **2008**, *34*, 1–20. [CrossRef]
60. Tervonen, L.; Kortelainen, M.; Kanninen, O. *Eliittilukioiden Vaikutukset Ylioppilaskirjoitusten Tuloksiin [The Effects of Elite General Upper Secondary Schools on the Results of the Matriculation Examination]*; VATT Institute for Economic Research: Helsinki, Finland, 2017.
61. Carless, D.; Boud, D. The Development of student feedback literacy: Enabling uptake of feedback. *Assess. Eval. High. Educ.* **2018**, *43*, 1315–1325. [CrossRef]
62. Nicol, D. Assessment for learner self-regulation: Enhancing achievement in the first year using learning technologies. *Assess. Eval. High. Educ.* **2009**, *34*, 335–352. [CrossRef]
63. Smith, C.D.; Worsfold, K.; Davies, L.; Fisher, R.; McPhail, R. Assessment literacy and student learning: The case for explicitly developing students 'assessment literacy.' *Assess. Eval. High. Educ.* **2013**, *38*, 44–60. [CrossRef]
64. Johnson, C.C.; Sondergeld, T.A.; Walton, J.B. A Study of the Implementation of Formative Assessment in Three Large Urban Districts. *Am. Educ. Res. J.* **2019**, *56*, 2408–2438. [CrossRef]
65. Figa, J.G.; Tarekegne, W.M.; Kebede, M.A. The Practice of Formative Assessment in Ethiopian Secondary School Curriculum Implementation: The Case of West Arsi Zone Secondary Schools. *Educ. Assess.* **2020**. [CrossRef]

66. Winstone, N.E.; Nash, R.A.; Parker, M.; Rowntree, J. Supporting learners' agentic engagement with feedback: A systematic review and a taxonomy of recipience processes. *Educ. Psychol.* **2017**, *52*, 17–37. [CrossRef]
67. Härmälä, M.; Huhtanen, M. *Ranskan Kielen A-ja B-Oppimäärän Oppimistulokset Perusopetuksen Päättövaiheessa 2013 [Outcomes of Learning in A and B Level French at the End of Basic Education in 2013]*; Finnish National Agency for Education: Tampere, Finland, 2014.
68. DeLuca, C.; Chavez, T.; Cao, C. Establishing a foundation for valid teacher judgement on student learning: The role of pre-service assessment education. *Assess. Educ. Princ. Pol. Pract.* **2013**, *20*, 107–126. [CrossRef]
69. Hildén, R.; Fröjdendahl, B. The dawn of assessment literacy—Exploring the conceptions of Finnish student teachers in foreign languages. *Apples. J. Appl. Lang. Stud.* **2018**, *12*, 1–24. [CrossRef]
70. Arrafi, M.A.; Sumarni, B. Teachers' understanding of formative assessment. *Lingua Cultura* **2018**, *12*, 45–52. [CrossRef]
71. Bennett, R.E. Formative assessment: A critical review. *Assess. Educ. Princ. Pol. Pract.* **2011**, *18*, 5–25. [CrossRef]

education sciences

MDPI

Article

Automated Feedback Is Nice and Human Presence Makes It Better: Teachers' Perceptions of Feedback by Means of an E-Portfolio Enhanced with Learning Analytics

Pihel Hunt [1,*], Äli Leijen [1] and Marieke van der Schaaf [2]

[1] Faculty of Social Sciences, Institute of Education, University of Tartu, 51005 Tartu, Estonia; ali.leijen@ut.ee
[2] Utrecht Center for Research and Development of Health Professions Education, University Medical Center Utrecht, 3584 CX Utrecht, The Netherlands; m.f.vanderschaaf-5@umcutrecht.nl
* Correspondence: pihel.hunt@ut.ee

Abstract: While there is now extensive research on feedback in the context of higher education, including pre-service teacher education, little has been reported regarding the use of feedback from teachers to other teachers. Moreover, literature on the potential advantages that the use of technology, for example electronic portfolios and learning analytics, has in improving feedback in the in-service workplace practices, is also sparse. Therefore, the aim of this exploratory case study was to explore how in-service teachers perceived the peer feedback they received and provided through a web-based electronic portfolio during a professional development course carried out in their workplace. Questionnaire and interview data were collected from 38 teachers who received feedback through a learning analytics enhanced electronic portfolio and from 23 teachers who received feedback only by the electronic portfolio. Additionally, one individual and four focus group interviews were conducted with 15 teachers who were the feedback providers. Several common topics were identified in the interviews with the feedback receivers and providers, involving the benefits and challenges of human interaction and the flexibility of the feedback process that the electronic portfolio offered. The results also revealed better feedback experience within the group of teachers who received extra feedback by means of learning analytics. It is concluded that although an electronic portfolio provides a useful tool in terms of flexibility in the provision and receipt of feedback, the need for human interaction was acknowledged.

Keywords: in-service teachers; feedback; e-portfolio; learning analytics

Citation: Hunt, P.; Leijen, Ä.; van der Schaaf, M. Automated Feedback Is Nice and Human Presence Makes It Better: Teachers' Perceptions of Feedback by Means of an E-Portfolio Enhanced with Learning Analytics. *Educ. Sci.* **2021**, *11*, 278. https://doi.org/10.3390/educsci11060278

Academic Editor: Kirsi Tirri

Received: 5 May 2021
Accepted: 31 May 2021
Published: 4 June 2021

1. Introduction

Teachers' professional development is a process that starts in pre-service education and continues throughout teachers' professional lives, involving several supporting features [1]. Effective professional development provides teachers with time to think about and receive input on making changes to their professional activities by reflection and feedback [2]. The importance and impact of feedback has been established in research. In their seminal article on feedback, Hattie and Timperley [3] conceptualise feedback as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding" (p. 81). This definition, however, has been criticised for focusing only on the transmission of information and not including any expectations for the feedback receivers to respond [4]. Current understandings of feedback, in the domain of higher education, include the ideas that feedback must have more beneficial developmental effects for the feedback receivers [5] and improve their work and learning [6,7]. However, this also constitutes the field of in-service teachers' education, where feedback (e.g., received from peers, mentors, school leaders) should give input to the improvement of their professional development. So far, when talking about in-service teachers, the literature

about feedback is rather sparse, mainly focusing on student learning. Consequently, more information is needed [8,9].

There is considerable debate about what makes feedback effective [10]. In their discussion about the conditions under which assessment supports learners' learning, Gibbs and Simpson [11] have established four conditions that focus on the characteristics of the feedback: quantity, timing, quality, and the use of feedback. In order to be effective, the feedback should be understandable, timely, sufficient in detail and quantity, and acted upon by the feedback receivers [11]. The immediacy of the feedback and its connection to the feedback content as a characteristic of effective feedback is also discussed by Hattie and Timperley [3]. They argue that the optimal timing of feedback varies depending on the feedback content. Simple error correction may be most effective when delivered immediately, however the delayed feedback on processes or complex tasks allows the feedback receivers time to carry out the task without interruptions. Scheeler and colleagues [8] also emphasize that immediate feedback can raise concerns about interruption of the flow of instruction. Therefore, feedback providers should investigate ways to provide immediate feedback in the least intrusive manner, but as close to the instructional event as possible [8].

Providing and receiving feedback is often complicated due to several aspects, such as the means through which it is delivered [8], the tasks, the content of the feedback, the context in which feedback is given, and the interplay between these aspects [12,13]. The feedback to support in-service teachers' learning and development can be provided by various sources, one of which is another teacher. Peer feedback is considered to be successful because the power differentials are minimized [8]. The input for this feedback may come from peer observations. In peer observations, peers should act as "critical friends" and this relies heavily on trust [14]. A study carried out by Parr and Hawe [15] showed that teachers value the possibility to observe one another's practice especially when these observations are carried out with a clear purpose and in a guided way. The teachers found the observations to be a 'very useful professional learning activity' (p. 724).

Technological developments offer new and different forms of professional development for teachers [16]. In order to benefit from these technological tools, it is vital that teachers know how to use them [17]. Therefore, the importance of teachers' digital or ICT competence in teachers' professional development is emphasized in several guidelines for teachers. In the ICT Competency Framework for Teachers [18] it is stated that ICT-competent teachers guide their students to develop their ICT competencies, as well as use ICT for their own professional improvement. A similar idea can be found in the European Framework for the Digital Competence of Educators—in addition to enhancing teaching, teachers' digital competence entails fostering their own professional development by using digital technologies [19]. Although digital or ICT competence is considered as an important factor to improve teachers' professional development, the teachers lack qualifications and have insufficient training in ICT [20].

Many technological tools have been applied to support teachers' professional development. For example, Aubusson and colleagues [21] showed that mobile technologies have the capacity to add new dimensions to teacher professional learning. Their study also supports the literature indicating that teachers are more eager to use technology for their students' learning rather than for their own learning. In order to support teachers in reflecting on their practice based on everyday evidence and feedback, three design-based research iterations were carried out by Prieto and colleagues [22]. The suggestions that authors give based on their study include, among others, attention to ownership (teachers should be able to personalise the items/behaviours to observe and reflect upon) and design for overload (it should be considered that teachers may lack spare energy and attention during the school day).

Reflection is also at the centre of portfolios [23] and electronic portfolios (e-portfolios), which have been used among teachers to support their professional learning and the provision and receipt of feedback [24–29]. There are also studies suggesting that implementing e-portfolios takes too much time and effort [30,31], the implementation needs a lot of

support [24,32], and it does not necessarily enhance the development of teaching competencies [33]. Therefore, new feedback models should be considered. Pardo [34] argues that new feedback models need to consider combining computer-based and human-produced feedback into a more precise description, involving elements that capture the interaction between learners, computers, instructors and resources at different design levels. One way to do this is by the implementation of learning analytics (LA), i.e., "the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs" [35]. LA is conceived as an effective and efficient way to provide immediate feedback [36] and therefore improve the quality of the learning processes [37]. In this way e-portfolios could possibly be used in a more tailored and timely manner [38]. However, Clow [39] emphasises that learning is improved by the LA system only then when the given feedback reflects and rewards those aspects of learning that are valued by the learners. What is more, to date a number of studies have focused on the feedback receiver, especially in the context of peer feedback, and the possible learning benefits of providing feedback in online settings have not been extensively studied [40].

Research has shown that feedback processes, whether carried out in person or through some digital medium, can shape the learner's behaviour, learning, and experience [41]. The feedback receiver and provider play the central role as the agents of the feedback process. Depending on the context, numerous agents could be involved in the feedback process [42], bringing their own different subjective perceptions and experiences into the process [43,44]. The perceptions and experiences of the different agents in the feedback process have been widely researched in the context of higher education [41,45–47]. In pre-service education, there is also a large and growing number of published studies about the perceptions and experiences of feedback. For example, Ferguson [48] studied students' perceptions of quality feedback in teacher education, Dowden and colleagues [46] investigated pre-service teachers' perceptions of written feedback, and Buhagiar [49] examined mathematics student teachers' views on tutor feedback during teaching practice. In in-service teacher education, a considerable amount of literature has been published on teachers' perceptions of feedback that they provide to their students e.g., [12]. However, so far, research about feedback processes regarding in-service teachers is still sparse [8]. This also counts for research regarding in-service teachers' perceptions of feedback in innovative digital learning environments.

The context in which the feedback is shared also plays an important part in the feedback process. The context of this study is a professional development course aimed at in-service teachers. Parsons and colleagues [16], who studied teachers' interpretations about their online professional development experiences, found that the teachers indicated several factors that made the online professional development beneficial, especially the possibility to access and complete the course at any time and at their own pace. Powell and Bodur [50] examined teachers' mixed perceptions of design and implementation features of a job-embedded online teacher professional development experience. On the one hand, the participants in their study saw reflection as a key element of online teacher professional development. On the other hand, the lack of social interaction and collaboration was seen as a weakness in the process.

In sum, feedback, although having an important part in the learning process, includes several factors that make the feedback process challenging. The use of technology, more specifically e-portfolios and LA, may have a number of potential advantages as a means of providing and receiving feedback in the workplace practices. The perceptions of the feedback of the agents involved in the feedback process shape the potential learning. Few studies have investigated the implementation of technology in in-service teachers' professional learning. In this exploratory case study, we aim to present teachers' perceptions about receiving and providing feedback by the means of a web-based e-portfolio during a professional development course carried out in their workplace. We seek answers to the following research questions:

1. How do teachers as feedback receivers perceive the feedback by the means of an e-portfolio?
2. Is there a difference between the perceptions of feedback receivers who received extra feedback by the means of learning analytics in the e-portfolio?
3. How do teachers as feedback providers perceive giving feedback by the means of an e-portfolio?

2. Materials and Methods

An exploratory case study methodology [51] was chosen to explore in-service teachers' perceptions of feedback that was received and provided by the means of an e-portfolio.

2.1. Research Context

The literature speaks about several types of e-portfolios, such as showcase portfolio, assessment portfolio, learning portfolio, reflective portfolio [52]. A web-based e-portfolio, named Electronic Portfolio Assessment and Support System (EPASS), was used in this study. It provides users with tools for assessment, feedback and reflection. EPASS enables the collection of specific information about the performance and development of the users within a competency framework. This competency framework was developed with the collaboration of Estonian and Dutch teacher educators and then adapted into an Estonian context. The framework was adapted to the form of an assessment rubric, containing five professional roles, twelve professional activities and five performance levels for each (see further [53]).

The e-portfolio was enhanced with two LA applications. The Just-in-Time (hereafter JIT) feedback module provided users with automated feedback messages determined on the performance scores in the e-portfolio and defined based on the rubric. Moreover, the users could also see written personalised feedback in the JIT feedback module inserted by the feedback provider. An example of the automated feedback and the written feedback is presented in Table 1.

Table 1. Examples of the Feedback in the JIT Feedback Module.

Feedback	Example
Automated	You are at level 2 (sufficient) on "Plans the execution of learning activities" In order to achieve the next level, you should: "Plan a lesson that is clearly structured: introduction, core and closing. Have an alternative plan for different (to be expected) situations".
Written	You are good at anticipating different and often unexpected situations. You can find solutions really quickly and continue with the lesson at a calm pace. Your lesson is timely planned, but you still have left spare time for unexpected situations.

The second LA application was the Visualisation (hereafter VIZ) module. This module gave the users a visual overview of their development in different ways based on the users' wishes (e.g., in the form of a line graph, bar chart, spider diagram, table). The different features of the VIZ module are presented in Figure 1.

Figure 1. VIZ Module in the E-portfolio Dashboard (**A**), Example of the Timeline Graph (**B**), Example of the Spider Diagram (**C**), Example of the Bar Chart (**D**), and Example of the Table (**E**).

A four-week in-service teacher professional development course "Lesson observation and analysis" was carried out. The course consisted of two seminars, at the beginning and at the end of the course at the university, and a practical task in the workplace. The practical task involved the deployment of the e-portfolio as a means to help the in-service teachers to gain more effective feedback on their professional activities and therefore enhance their professional development.

Altogether, five groups of teachers were formed; three experimental and two control groups. In the first seminar, the groups were given an overview of the requirements for the course and of the e-portfolio; the teachers were provided with manuals and videos of how to use the e-portfolio as a means for providing and receiving feedback. For three experimental groups, an overview of the LA applications was provided, and the teachers in the control groups did not see the LA applications in the e-portfolio. Then, as a practical task, the teachers were asked to receive or provide feedback on three lessons at their workplace during the period of one month. If the teachers decided to receive feedback on their activities, they were given access to the e-portfolio and they were asked to find a colleague who would observe their activities in the lesson and then receive feedback through the e-portfolio. Vice versa, if the teachers wanted to provide feedback, they were asked to find a colleague who they would observe and provide feedback through the e-portfolio. However, the feedback providers did not have access to the e-portfolio and they used the e-portfolio as external users.

The feedback receivers were asked to fill in the feedback form in the e-portfolio for context information (e.g., the name of the school, subject, etc.) and send it to the feedback provider with the request to fill in the form. The feedback provider then observed the lessons of the feedback receiver, marked the performance levels and provided written feedback in the form in the e-portfolio. Based on the scores the feedback provider marked, the feedback receivers received information about their activities in the e-portfolio. The feedback receivers in the experimental groups also received automated feedback in the JIT feedback module and the graphical representations of their professional activities' scores in the VIZ module. Through the course, constant support was provided via e-mail. The course ended with another seminar at the university where the teachers could reflect on their experiences and data were collected from the participants.

2.2. Participants

The overall course enrolment was 135 teachers, with 56% volunteering to participate in the study. Data were collected from two samples. The first sample consisted of 61 in-service teachers who used the e-portfolio to receive feedback from their colleagues. The experimental group of feedback receivers (N = 38, distributed across three groups) used the e-portfolio with LA, and the control group (N = 23, distributed across two groups) used the e-portfolio without the LA. Fifty-nine of the participants were female and two were male. The teachers' age varied from 25 years to 67 years and the mean age was 44.48, SD = 10.54 (experimental group: 25–67, M = 43.35, SD = 11.06, control group: 27–62, M = 46.30, SD = 9.60). Out of 61 in-service teachers, 33 had previous experiences with e-learning environments (22 in experimental and 11 in the control group). Only 13 teachers had previous experiences with e-portfolios (8 in experimental and 5 in the control group). The second sample consisted of 15 in-service teachers who gave feedback to their colleagues via the e-portfolio.

2.3. Data Collection

To understand whether there is a difference between the experimental and control group in feedback perception among the feedback receivers, the adapted Assessment Experience Questionnaire (AEQ) [54] was administered. The AEQ examines the extent to which learners experience various conditions of learning. Three scales that are related to feedback in the questionnaire were used: quantity and timing of feedback (5 items, α = 0.54; e.g., I get plenty of feedback on my professional activities from my colleague via EPASS), quality of feedback (6 items, α = 0.81; e.g., The feedback my colleague provides me, via EPASS, shows me how to do better next time) and how the feedback is used (4 items, α = 0.81; e.g., I use the feedback my colleague provides me, via EPASS, to adapt my behaviour and activities). In total, the questionnaire consisted of 15 items, α = 0.85. For all parts of the questionnaire, the responses were given on a 5-point Likert-type scale (1—fully disagree, 5—fully agree).

Qualitative data from the feedback receivers were gathered with open-ended questions in the questionnaire and focus group interviews. Participants were asked in the interviews what they thought about the feedback they received and how they used the received feedback. The teachers in the experimental group were also asked to comment on the different LA applications—how useful they found the visualised, automated and written feedback, how they understood the feedback they received via the LA applications, and how they used the received feedback.

Data from the feedback providers were collected during the last seminar of the professional development course in the university with interviews, involving one individual and four focus group interviews (number of participants ranging from two to five). The feedback providers were asked about their perceptions about the feedback provision process, how the use of the system affected the feedback they gave, what impact the feedback had on the receiver and how the feedback was used by the receiver in their perception.

2.4. Data Analysis

Shapiro-Wilk test was used for testing the normality of the AEQ scores of the whole scale and three subscales in the questionnaire. For comparisons of the experimental and control group, independent-samples t-test was used in case of parametric data, and the Mann–Whitney U-test for non-parametric data. However, the results regarding one subscale (quantity and timing of feedback) are considered with caution since the Cronbach's alpha of this subscale was rather low.

Open-ended responses in the questionnaire and the focus group interviews were analysed following the inductive thematic analysis procedure [55] in order to find common themes in participants' responses. This means that data were explored without any predetermined framework and themes were inductively drawn from the data. Two researchers read the open-ended responses, interview notes, and reports several times to acquaint

themselves with the data. As the next step, initial codes were generated and compared between two researchers. Based on the similarities, the codes were then grouped into themes. As the final step, a detailed description of the results was written and illustrated with quotations.

3. Results

The results are grouped into two parts. Results about the perceptions of the feedback receivers are based on questionnaire and interview data, whilst the second part, perceptions of the feedback providers, draws only on the qualitative data.

3.1. Perceptions of the Feedback Receivers

The first question in this study sought to explore how the teachers as feedback receivers perceived the feedback by the means of an e-portfolio. Based on the qualitative data, the feedback receivers pointed out the ways in which they organised the timing of the feedback process. One possibility for structuring the process was that the feedback provider and the feedback receiver sat together after the observation, had a discussion, and filled in the e-portfolio jointly. One participant brought out: "It was best to fill in the e-portfolio together after the lesson—you can discuss with your colleague and insert feedback at the same time". The second possibility of how the process was structured involved the discussion between the feedback provider and the feedback receiver after the lesson, however, the feedback provider filled in the e-portfolio after the discussion independently. This way, the feedback provider could choose the time at which to insert the feedback in the e-portfolio. This structure was criticised by a feedback receiver indicating that "when my colleague gave me oral feedback right after the lesson, it was frustrating for her to fill in the same comments in the e-portfolio afterwards". Therefore, this option was seen as double the work for feedback providers.

There was also an option not to have a discussion at all between the feedback provider and the feedback receiver and the feedback was inserted in the e-portfolio independently right after the observation or with a delay by the feedback provider. This possibility was met with mixed feelings. On the one hand, this enabled more flexibility for the participants in the feedback process. As one feedback receiver said: "The e-portfolio made the feedback process more compact. When it is really busy at school, we do not have the time to sit and talk. My colleague could fill in the feedback when she had time and I could read it afterwards when I have time". On the other hand, this way the timing of the feedback really depended on both parties. The teachers indicated that although the e-portfolio itself provided feedback at the same moment, if the feedback provider did not insert the feedback data in the e-portfolio, the feedback was delayed. The same was true for feedback receivers, as one teacher noted: "It was difficult to understand the feedback. Maybe I read it too long after the lesson". Thus, it was more beneficial for the feedback receivers to receive and correspond to the feedback immediately after the task.

The teachers pointed out that they valued the possibility to choose the activities they wanted to receive feedback on. This made the process more personalised for them. Even though the participants indicated that they valued the comments from their colleagues rather than the scores in the feedback form, the challenges of the written feedback were also addressed. One participant emphasised that because written feedback can be misunderstood, there should always be a face-to-face meeting. As one participant put it: "I am afraid that my colleague was not honest with me". Therefore, the face-to-face meeting gave the participants the possibility to discuss the feedback further.

The second research question aimed to understand whether there was a difference in the perceptions between the experimental group and the control group of teachers. In other words, whether there were differences in the two groups of feedback receivers: the experimental group received feedback through the e-portfolio which was enhanced with LA, the control group did not see the LA. With regard to the results focusing on the quantity and timing of the feedback, no statistically significant difference in scores were

identified between the experimental (M = 3.44, SD = 0.56) and the control group (M = 3.26, SD = 0.55). Although the scores in the quality of the feedback scale were higher in the experimental group (Mdn = 3.85) compared to the control group (Mdn = 3.67), the difference was not statistically significant. This also constitutes what the teachers do with the received feedback where Mann-Whitney U test showed no statistically significant difference between the experimental (Mdn = 4.10) and the control group (Mdn = 3.88). However, the whole feedback experience was estimated as significantly higher in the experimental group with LA (M = 3.78, SD = 0.45), $t(59) = -2.1$, $p < 0.05$ compared to the control group (M = 3.50, SD = 0.60) with no LA. Following this, the results from the qualitative data will be reported in order to understand the feedback receivers' perceptions in more depth.

The teachers who could see the LA applications had mixed feelings about how understandable the feedback in the LA modules was. On the one hand, the participants noted that the JIT feedback module was an "eye-catcher" but on the other, the feedback in the VIZ module was more useful. As one participant noted: "I did not understand the JIT module. Since my colleague did not write anything in the comments' section, I saw no value in it. However, I liked the VIZ module, it gave me information and overview of my activities". In terms of the quantity of the received feedback, some of the participants in the experimental group indicated that there was too much detailed information in the LA modules. As one participant noted: "The picture was too colourful, there were too many things". Several teachers who had the possibility to see LA would have liked to get more aggregated feedback and not so many different choices.

Overall, the feedback received through the e-portfolio was perceived as useful for further discussion and reflection. The participants indicated that the e-portfolio enabled them to revise the feedback whenever they wanted as the feedback was together in one system. In order to gain more from the feedback, the participants suggested that more training on how to understand and benefit from the feedback in the LA applications should be provided.

3.2. Perceptions of the Feedback Providers

The third research question set out to explore how the teachers as feedback providers perceived the feedback. Data from the feedback providers were collected with one individual and four focus group interviews.

The feedback providers were asked how the use of the system affected the way they gave the feedback. Similar to the feedback receivers, the answers to these questions were divided into two parts. There were some feedback providers that preferred to discuss their observations right after the lessons and fill in the feedback form with the colleague they had been observing. By contrast, there were teachers who took some time after the lesson observation, gathered their thoughts and filled in the feedback in the e-portfolio alone after some time had passed (e.g., in the evening at home). Although the e-portfolio provided enough flexibility for the feedback providers on when to fill in the feedback, they all agreed that the feedback filled in the feedback form should always be accompanied with oral feedback because "you cannot write the feedback that you have not said before".

Almost all feedback providers agreed that using the e-portfolio made their feedback more specific and structured. According to most of the feedback providers, the structure lay in the feedback form that provided specific criteria for the assessment procedure. As one feedback provider put it: "I could see that the professional activities with their level descriptions in the feedback form were based on the teachers' standard, but the feedback form provided even more precise activities". However, there were feedback providers who were critical about this rubric, indicating that "it was too general to provide specific feedback or the differences between the levels were too small making it difficult to choose the right one".

There was no consensus in the perceptions of the written feedback among the participants. Some of the feedback providers appreciated the possibility to write the feedback in

the comments section. For example, one interviewee said: "I like that I could add my own feedback after marking the score. I felt I could add something extra to the existing criterion. The existing criterion directed me to think and pay attention to aspects that otherwise may have been unnoticed". Nevertheless, some feedback providers did not like that writing the comments was obligatory. They felt that some things were already said in the performance level descriptions and therefore they had to use copy and paste or they wrote only a dash in the comments section. Moreover, there were feedback providers who said that they had given all their comments in the discussion and therefore filling in the comments section in the e-portfolio was demotivating.

Several feedback providers stated that in their opinion, the e-portfolio was useful for their colleagues as they benefited a lot from the feedback they received because the e-portfolio was seen as a good tool for reflection. However, there was one feedback provider who found the e-portfolio to be "a distant tool that does not foster discussion or reflection".

Another interesting topic that emerged was that the feedback providers admitted that giving feedback for a colleague was a unique situation and they felt that they were supposed to be friendly with them. Therefore, they did not give too much critical feedback and also rated their colleagues with high scores. Overall, the feedback providers were rather positive about the experience with giving feedback via the e-portfolio. The consensus was that using the e-portfolio made giving the feedback easier and developed their feedback providing skills.

4. Discussion and Conclusions

This exploratory case study looked at the perceptions of the feedback process of in-service teachers who received and provided feedback through a web-based e-portfolio during a professional development course in their workplace. Several common topics were identified among the two groups.

The importance of oral feedback and discussion in the feedback process was emphasised in almost all interviews by both groups—the feedback receivers and providers. Although the e-portfolio was seen as a good tool to gather, record and contain the feedback, the participants indicated that feedback is created in interaction and therefore face-to-face discussions should also be part of the process. This topic was also emphasized by Powell and Bodur [33] who showed in their study that the lack of social interaction and collaboration was seen as a weakness in an online teacher professional development experience. This means also that better balance combining computer-based and human-produced feedback should be found [34].

The receipt and provision of feedback within this study was conducted between peers. This, however, was noted as a challenge by the participants even if the importance of social interaction was emphasised. The feedback providers indicated the feeling of not being able to be critical to their colleagues and the feedback receivers felt that the feedback providers had not been honest with them. Teachers could choose the peers they wanted to involve in the feedback process themselves and therefore it seems that they chose the peers they felt most comfortable with. Shortland [14] emphasises the importance of the peer observation partners' selection and warns that feedback can be dangerous to relationships—if perceived as critical it may damage the relationship, however, little gain is served if the problem is avoided. Therefore, the peer should not only be a "friend" or yet alone only "critical", but rather act as a "critical friend". Additionally, taking time to review another person's work can encourage teachers to examine their own activities and viewpoints, and therefore providing peer feedback has potential learning benefits for the provider as well [40]. Overall, building this sort of relationship takes time and trust [14].

One common topic was the flexibility of the feedback process that the e-portfolio offered and this was seen as its most beneficial aspect. Both groups described the ways in which they had structured the feedback process and in a broad sense, three patterns emerged. The flexibility of the feedback process is important, however, all of these patterns involved benefits and challenges indicated by the participants. The first pattern where

the feedback provider and receiver sat together after the observation, had a discussion, and filled in the e-portfolio jointly was seen as beneficial but time-consuming. The second pattern where the feedback provider and the receiver sat together after the observation, had a discussion, but the feedback provider filled in the e-portfolio after the discussion independently enabled the feedback provider to take some time to think through what to write in the e-portfolio. However, this pattern was often seen as double work by the feedback providers. The third pattern, where the feedback provider and the feedback receiver did not have a discussion after the observation and the feedback provider inserted the feedback in the e-portfolio independently right after the observation or with a delay, was the most time-saving, however, the lack of oral feedback and discussion was mentioned as a weakness of this pattern. One criterion for the effective provision of feedback is that the timing of the provision needs to be agreed upon and needs to reflect the balance between the requirements for immediacy and considered reflection [14]. This also supports the idea of Prieto and colleagues [22], that technological tools for teachers' professional development should be "designed for overload"—teachers may lack spare energy and attention during the school day and therefore can choose the pattern most suitable for them.

The feedback framework that the e-portfolio offered was also mentioned by both of the groups. The feedback providers valued the structured criteria as the basis for the e-portfolio and the LA applications for their observations. Although there were some critical comments about the framework suggesting that the criteria were too general or the performance levels were too similar, having a clear framework as a guidance in the feedback process has also been emphasized in the literature [15]. Gašević, Dawson and Siemens [56] have also emphasised that the LA approach only holds a promise to improve learning when it is developed from theoretically established instructional strategies. The feedback receivers saw the main benefit in the personalisation the framework offered, having the possibility to choose for themselves the activities they wanted to receive feedback on. This result is consistent with the idea by Clow [39], who pointed out that learning is improved by the LA system only then when the given feedback reflects and rewards those aspects of learning that are valued by the learner. If the teachers cannot choose the activities by themselves, the feedback that the LA system provides is not meaningful to the teachers and does not enhance their learning. This supports the suggestion by Prieto and colleagues [22], that in designing the tools for teacher reflection, special attention should be given to allowing teachers to take ownership of their own learning.

Another interesting result was that although the whole feedback experience was perceived as significantly higher by the group of teachers who saw LA, there were no significant differences in perceptions of the quantity, quality and use of feedback between the two groups. Although Pardo [34] notes that LA could improve the overall learners' experience, the teachers in this study had mixed perceptions about the LA applications, indicating that understanding of information in the LA applications took time and the extra value of the LA applications was limited. Although training on how to use the system was provided to the teachers, according to the teachers they needed even more support. This may have been due to the fact that teachers may lack digital skills. In addition, more attention should have been given to supporting their uptake of feedback and feedback literacy [6,7,57].

When interpreting the results, it must be noted that the teachers in the study volunteered to participate, a characteristic that may have shaped their perceptions. The e-portfolio was tested over a period of one month only during a professional development course. The implementation of new technology takes a lot of time and effort in order to be of more benefit and therefore a longer period of time should be allocated for the implementation. A third limitation is that the study examined a particular e-portfolio and LA applications that is not generalizable to other types of e-portfolios and LA applications. A different e-portfolio system and course design may have revealed features that could further contribute to feedback research.

The current study focused on teachers' perceptions of feedback. Although perceptions of feedback have implications for the acceptance and use of feedback [58], we still do not know how the teachers really used the feedback they received through the e-portfolio and whether there was an improvement in their competencies. A further study could investigate the actual uptake and use of the feedback in which teachers apply the feedback to improve their subsequent activities. Given the diverse sample of in-service teachers, research could also explore whether their digital or ICT competence may impact teachers' perceptions of the feedback received or provided via the e-portfolio. Moreover, feedback on teachers' activities was not collected from students—the stakeholders who teachers' learning should most affect. Students should not be a feature in the background, but rather have an active voice in teachers' professional development process [22].

To conclude, despite the contextuality of our research process, the perspectives of teachers about the feedback they received and provided through the e-portfolio provide an implication for the feedback research among in-service teachers and for the broader field of teachers' professional development. Although the e-portfolio with learning analytics offered different possibilities (e.g., automated and visualised feedback) to enhance the learning and development of teachers, human presence and interaction was still highly valued by teachers, despite the time and effort it required. In order to benefit from the feedback, extra attention should be given to the training and support in using the system, with special focus on how to understand the feedback in the LA and how to implement it in the subsequent activities.

Author Contributions: Conceptualisation, M.v.d.S., P.H. and Ä.L.; methodology, M.v.d.S., P.H. and Ä.L.; formal analysis, P.H.; investigation, P.H.; resources, M.v.d.S. and Ä.L.; data curation, P.H.; writing—original draft preparation, P.H.; writing—review and editing, P.H., Ä.L. and M.v.d.S.; supervision, Ä.L. and M.v.d.S.; project administration, M.v.d.S.; funding acquisition, M.v.d.S. All authors have read and agreed to the published version of the manuscript.

Funding: This study was conducted as part of the "Workplace-Based e-Assessment Technology for competency-Based Higher Multi-Professional Education" (WATCHME) project supported by the European Commission 7th Framework Programme (grant agreement No. 619349).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are not publicly available due to privacy or ethical restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Sancar, R.; Atal, D.; Deryakulu, D.A. New Framework for Teachers' Professional Development. *Teach. Teach. Educ.* **2021**, *101*. [CrossRef]
2. Darling-Hammond, L.; Hyler, M.E.; Gardner, M. *Effective Teacher Professional Development*; Learning Policy Institute: Palo Alto, CA, USA, 2017; pp. 14–15.
3. Hattie, J.; Timperley, H. The Power of Feedback. *Rev. Educ. Res.* **2007**, *77*, 81–112. [CrossRef]
4. Boud, D.; Molloy, E. Rethinking Models of Feedback for Learning: The Challenge of Design. *Assess. Eval. High. Educ.* **2013**, *38*, 698–712. [CrossRef]
5. Winstone, N.E.; Nash, R.A.; Parker, M.; Rowntree, J. Supporting Learners' Agentic Engagement With Feedback: A Systematic Review and a Taxonomy of Recipience Processes. *Educ. Psychol.* **2017**, *52*, 17–37. [CrossRef]
6. Carless, D.; Boud, D. The Development of Student Feedback Literacy: Enabling Uptake of Feedback. *Assess. Eval. High. Educ.* **2018**, *43*, 1315–1325. [CrossRef]
7. Carless, D.; Winstone, N. Teacher Feedback Literacy and Its Interplay with Student Feedback Literacy. *Teach. High. Educ.* **2020**, 1–14. [CrossRef]
8. Scheeler, M.C.; Ruhl, K.L.; McAfee, J.K. Providing Performance Feedback to Teachers: A Review. *Teach. Educ. Spec. Educ. J. Teach. Educ. Div. Counc. Except. Child.* **2004**, *27*, 396–407. [CrossRef]
9. Thurlings, M.; Vermeulen, M.; Kreijns, K.; Bastiaens, T.; Stijnen, S. Development of the Teacher Feedback Observation Scheme: Evaluating the Quality of Feedback in Peer Groups. *J. Educ. Teach.* **2012**, *38*, 193–208. [CrossRef]

10. Shute, V.J. Focus on Formative Feedback. *Rev. Educ. Res.* **2008**, *78*, 153–189. [CrossRef]
11. Gibbs, G.; Simpson, C. Conditions Under Which Assessment Supports Students' Learning. *Learn. Teach. High. Educ.* **2004**, 3–33. [CrossRef]
12. Brown, G.T.L.; Harris, L.R.; Harnett, J. Teacher Beliefs about Feedback within an Assessment for Learning Environment: Endorsement of Improved Learning over Student Well-Being. *Teach. Teach. Educ.* **2012**, *28*, 968–978. [CrossRef]
13. Thurlings, M.; Vermeulen, M.; Bastiaens, T.; Stijnen, S. Understanding Feedback: A Learning Theory Perspective. *Educ. Res. Rev.* **2013**, *9*, 1–15. [CrossRef]
14. Shortland, S. Feedback within Peer Observation: Continuing Professional Development and Unexpected Consequences. *Innov. Educ. Teach. Int.* **2010**, *47*, 295–304. [CrossRef]
15. Parr, J.M.; Hawe, E. Facilitating Real-Time Observation of, and Peer Discussion and Feedback about, Practice in Writing Classrooms. *Prof. Dev. Educ.* **2017**, *43*, 709–728. [CrossRef]
16. Parsons, S.A.; Hutchison, A.C.; Hall, L.A.; Parsons, A.W.; Ives, S.T.; Leggett, A.B. U.S. Teachers' Perceptions of Online Professional Development. *Teach. Teach. Educ.* **2019**, *82*, 33–42. [CrossRef]
17. Hennessy, S.; Dragovic, T.; Warwick, P. A Research-Informed, School-Based Professional Development Workshop Programme to Promote Dialogic Teaching with Interactive Technologies. *Prof. Dev. Educ.* **2018**, *44*, 145–168. [CrossRef]
18. UNESCO. *UNESCO ICT Competency Framework for Teachers*; United Nations Educational, Scientific and Cultural Organization: Paris, France, 2018; pp. 1–66.
19. Redecker, C. *European Framework for the Digital Competence of Educators: DigCompEdu*; Punie, Y., Ed.; Publications Office of the European Union: Luxembourg, 2017; pp. 38–40. [CrossRef]
20. Fernández-Batanero, J.M.; Montenegro-Rueda, M.; Fernández-Cerero, J.; García-Martínez, I. Digital Competences for Teacher Professional Development. Systematic Review. *Eur. J. Teach. Educ.* **2020**, 1–19. [CrossRef]
21. Aubusson, P.; Schuck, S.; Burden, K. Mobile Learning for Teacher Professional Learning: Benefits, Obstacles and Issues. *ALT J.* **2009**, *17*, 233–247. [CrossRef]
22. Prieto, L.P.; Magnuson, P.; Dillenbourg, P.; Saar, M. Reflection for Action: Designing Tools to Support Teacher Reflection on Everyday Evidence. *Technol. Pedagog. Educ.* **2020**, *29*, 279–295. [CrossRef]
23. van der Schaaf, M.F.; Stokking, K.M. Developing and Validating a Design for Teacher Portfolio Assessment. *Assess. Eval. High. Educ.* **2008**, *33*, 245–262. [CrossRef]
24. Granberg, C. E-Portfolios in Teacher Education 2002-2009: The Social Construction of Discourse, Design and Dissemination. *Eur. J. Teach. Educ.* **2010**, *33*, 309–322. [CrossRef]
25. Hamilton, M. Evidence-Based Portfolios: A Cross-Sectoral Approach to Professional Development among Teachers. *Prof. Dev. Educ.* **2018**, 1–15. [CrossRef]
26. Kori, K.; Pedaste, M.; Leijen, Ä.; Mäeots, M. Supporting Reflection in Technology-Enhanced Learning. *Educ. Res. Rev.* **2014**, *11*, 45–55. [CrossRef]
27. Slepcevic-Zach, P.; Stock, M. ePortfolio as a Tool for Reflection and Self-Reflection. *Reflective Pract.* **2018**, *19*, 291–307. [CrossRef]
28. Strudler, N.; Wetzel, K. The Diffusion of Electronic Portfolios in Teacher Education: Issues Of Initiation and Implementation. *J. Res. Technol. Educ.* **2014**, *37*, 411–433. [CrossRef]
29. Wray, S. Electronic Portfolios in a Teacher Education Program. *E Learn. Digit. Media.* **2007**, *4*, 40–51. [CrossRef]
30. Evans, M.A.; Powell, A. Conceptual and Practical Issues Related to the Design for and Sustainability of Communities of Practice: The Case of E-portfolio Use in Preservice Teacher Training. *Technol. Pedagog. Educ.* **2007**, *16*, 199–214. [CrossRef]
31. Kabilan, M.K.; Khan, M.A. Assessing Pre-Service English Language Teachers' Learning Using e-Portfolios: Benefits, Challenges and Competencies Gained. *Comput. Educ.* **2012**, *58*, 1007–1020. [CrossRef]
32. Kankaanranta, M. Constructing Digital Portfolios: Teachers Evolving Capabilities in the Use of Information and Communications Technology. *Teach. Dev.* **2001**, *5*, 259–275. [CrossRef]
33. Struyven, K.; Blieck, Y.; De Roeck, V. The Electronic Portfolio as a Tool to Develop and Assess Pre-Service Student Teaching Competences: Challenges for Quality. *Stud. Educ. Eval.* **2014**, *43*, 40–54. [CrossRef]
34. Pardo, A. A Feedback Model for Data-Rich Learning Experiences. *Assess. Eval. High. Educ.* **2018**, *43*, 428–438. [CrossRef]
35. Siemens, G. Learning Analytics: The Emergence of a Discipline. *Am. Behav. Sci.* **2013**, *57*, 1380–1400. [CrossRef]
36. Johnson, L.; Adams Becker, S.; Cummins, M.; Freeman, A.; Ifenthaler, D.; Vardaxis, N. *Technology Outlook for Australian Tertiary Education 2013–2018: An NMC Horizon Project Regional Analysis*; New Media Consortium: Austin, TX, USA, 2013; pp. 1–28.
37. Greller, W.; Drachsler, H. Translating Learning into Numbers: A Generic Framework for Learning Analytics. *Educ. Technol. Soc.* **2012**, *15*, 42–57.
38. Aguiar, E.; Ambrose, G.A.A.; Chawla, N.V.; Goodrich, V.; Brockman, J. Engagement vs. Performance: Using Electronic Portfolios to Predict First Semester Engineering Student Persistence. *J. Learn. Anal.* **2014**, *1*, 7–33. [CrossRef]
39. Clow, D. An Overview of Learning Analytics. *Teach. High. Educ.* **2013**, *18*, 683–695. [CrossRef]
40. van Popta, E.; Kral, M.; Camp, G.; Martens, R.L.; Simons, P.R.-J. Exploring the Value of Peer Feedback in Online Learning for the Provider. *Educ. Res. Rev.* **2017**, *20*, 24–34. [CrossRef]
41. Adams, J.; McNab, N. Understanding Arts and Humanities Students' Experiences of Assessment and Feedback. *Arts Humanit. High. Educ.* **2013**, *12*, 36–52. [CrossRef]
42. Evans, C. Making Sense of Assessment Feedback in Higher Education. *Rev. Educ. Res.* **2013**, *83*, 70–120. [CrossRef]

43. Beaumont, C.; O'Doherty, M.; Shannon, L. Reconceptualising Assessment Feedback: A Key to Improving Student Learning? *Stud. High. Educ.* **2011**, *36*, 671–687. [CrossRef]
44. Carless, D. Differing Perceptions in the Feedback Process. *Stud. High. Educ.* **2006**, *31*, 219–233. [CrossRef]
45. Dawson, P.; Henderson, M.; Mahoney, P.; Phillips, M.; Ryan, T.; Boud, D.; Molloy, E. What Makes for Effective Feedback: Staff and Student Perspectives. *Assess. Eval. High. Educ.* **2018**, 1–12. [CrossRef]
46. Dowden, T.; Pittaway, S.; Yost, H.; McCarthy, R. Students' Perceptions of Written Feedback in Teacher Education: Ideally Feedback Is a Continuing Two-Way Communication That Encourages Progress. *Assess. Eval. High. Educ.* **2013**, *38*, 349–362. [CrossRef]
47. Mulliner, E.; Tucker, M. Feedback on Feedback Practice: Perceptions of Students and Academics. *Assess. Eval. High. Educ.* **2017**, *42*, 266–288. [CrossRef]
48. Ferguson, P. Student Perceptions of Quality Feedback in Teacher Education. *Assess. Eval. High. Educ.* **2011**, *36*, 51–62. [CrossRef]
49. Buhagiar, M.A. Mathematics Student Teachers' Views on Tutor Feedback during Teaching Practice. *Eur. J. Teach. Educ.* **2013**, *36*, 55–67. [CrossRef]
50. Powell, C.G.; Bodur, Y. Teachers' Perceptions of an Online Professional Development Experience: Implications for a Design and Implementation Framework. *Teach. Teach. Educ.* **2019**, *77*, 19–30. [CrossRef]
51. Yin, R.K. *Applications of Case Study Research*; Sage Publications, Inc.: Thousand Oaks, CA, USA, 2003.
52. Barrett, H.C.; Garrett, N. Online Personal Learning Environments: Structuring Electronic Portfolios for Lifelong and Life-wide Learning. *Horizon* **2009**, *17*, 142–152. [CrossRef]
53. Leijen, Ä.; Slof, B.; Malva, L.; Hunt, P.; van Tartwijk, J.; Schaaf, M. van der Performance-Based Competency Requirements for Student Teachers and How to Assess Them. *Int. J. Inf. Educ. Technol.* **2017**, *7*, 190–194. [CrossRef]
54. Gibbs, G.; Simpson, C. Measuring the Response of Students to Assessment: The Assessment Experience Questionnaire. In Proceedings of the 11th Improving Student Learning Symposium, Hinckley, UK, 1–3 September 2003.
55. Braun, V.; Clarke, V. Using Thematic Analysis in Psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
56. Gašević, D.; Dawson, S.; Siemens, G. Let's Not Forget: Learning Analytics Are about Learning. *TechTrends* **2015**, *59*, 64–71. [CrossRef]
57. Molloy, E.; Boud, D.; Henderson, M. Developing a Learning-Centred Framework for Feedback Literacy. *Assess. Eval. High. Educ.* **2020**, *45*, 527–540. [CrossRef]
58. Altahawi, F.; Sisk, B.; Poloskey, S.; Hicks, C.; Dannefer, E.F. Student Perspectives on Assessment: Experience in a Competency-Based Portfolio System. *Med. Teach.* **2012**, *34*, 221–225. [CrossRef] [PubMed]

education sciences

MDPI

Article

Finnish and Portuguese Parents' Perspectives on the Role of Teachers in Parent-Teacher Partnerships and Parental Engagement

Cristiana Levinthal [1,*], Elina Kuusisto [2] and Kirsi Tirri [1]

[1] Department of Educational Sciences, University of Helsinki, 00100 Helsinki, Finland; kirsi.tirri@helsinki.fi
[2] Faculty of Education and Culture, Tampere University, 33100 Tampere, Finland; elina.kuusisto@tuni.fi
* Correspondence: cristiana.levinthal@helsinki.fi

Abstract: The current educational reforms in Finland and Portugal require a holistic engagement of parents with learning, bringing parents and teachers together as partners. This qualitative study, which interviewed Finnish (N = 10) and Portuguese (N = 9) parents, aimed to explore parents' views on the role of teachers in supporting parent–teacher partnerships and parental engagement with the school. Inductive content analysis was performed to analyze the interviews. From a general standpoint, three patterns were found in the parents' narratives about the role of teachers in supporting partnership and engagement: communication, professionalism, and invitations to active parental participation. From a cross-cultural standpoint, Finnish parents evidenced partnerships and engagement grounded in little face-to-face contact but consistent online communication with the teacher, as well as trust in their professionalism and independent work. The Portuguese parents revealed rather frequent active participation within the school premises, more recurrent face-to-face communication with the teacher, and appreciation for teachers' timely responses and support. Recommendations for a holistic approach of engagement and partnerships were brought forward within the context of teacher education, such as the need to maintain simple but regular communication with parents and the relevance of reconsidering the frequency of parental activities in the school.

Keywords: parents' perspectives; teachers' support; parent–teacher partnerships; parental engagement; Finland; Portugal

Citation: Levinthal, C.; Kuusisto, E.; Tirri, K. Finnish and Portuguese Parents' Perspectives on the Role of Teachers in Parent-Teacher Partnerships and Parental Engagement. *Educ. Sci.* **2021**, *11*, 306. https://doi.org/10.3390/educsci11060306

Academic Editor: James Albright

Received: 16 April 2021
Accepted: 16 June 2021
Published: 21 June 2021

1. Introduction

1.1. Parent–Teacher Partnerships and Parental Engagement

The positive influence of parental engagement in education on children's learning and achievement is universally acknowledged [1,2]. However, parental engagement is dependent on effective parent–teacher partnerships and on teachers' support for engagement [1]. Traditionally, the parental role has been constructed as more reactive than active [3,4]. However, current educational aims for a holistic pedagogy [5] call for the urgent activation of parents' full potential to partner with teachers in order to promote the education of the whole person. The aim of this article is to explore parents' perspectives on the role of teachers in supporting parent–teacher partnerships and parental engagement in school, in pedagogically holistic school contexts.

Parents' engagement in education is a multidimensional construct encompassing a variety of perspectives and definitions [6,7]. Nevertheless, it has traditionally been studied based on a school-centered approach, that is, focused on parents' and families' assistance in satisfying school needs. In contrast to school-centered approaches, a holistic pedagogy not only seeks to teach content-related knowledge, such as math, science, or languages, but it also strives to help students develop a set of skills, values, and attitudes that will result in them becoming autonomous, proactive, and competent global citizens [5]. Holistic pedagogical schools are learning-centered, as opposed to school-centered, as they aim

for the comprehensive development of the student. We propose that a learning-centered approach to parents is required for schools to achieve full success in holistic pedagogy. In this article, we adopt Janet Goodall's [1] contemporary learning-centered framework of parent–teacher partnerships and parental engagement.

From this perspective, different forms of parental engagement are acknowledged as important, providing they maintain the centrality of children's learning and are supported by a well-grounded parent–teacher partnership [1]. Although parental engagement and parent–teacher partnerships are not synonyms, the latter plays an important and indissociable role in the former. Being partners reflects the shared responsibilities parents and teachers carry out throughout children's schooling and learning paths [6]. It is only by allowing such shared roles, as opposed to separated or sequential roles, that parents can genuinely be engaged with learning. Partnerships are, therefore, grounded in collaboration towards the children's learning. According to Goodall, the key features of an effective and genuine partnership are that teachers and parents engage in dialogue around and with the learning of the child; teachers and parents value each other's knowledge and legitimate the authority of each other's roles; and teachers and parents participate in supporting learning (for a detailed description of the framework, see Authors) [8]. Research on partnership and engagement has evolved to legitimate a more active and empowered parental role [1,6,7,9]. However, the teacher, regarded as the reference actor within the classroom, has consistently been pointed out in studies as a central enabling figure of parental engagement [1,9]. The teacher's role in encouraging participation is to promote parents' engagement by suggesting activities or inviting meaningful participation in and outside the school [10,11]. For example, a parent–teacher meeting about a child's progress, parental homework support, or a parent and child reading a book together in the park are all activities that illustrate learning-centered parental engagement. The difference between these interactions is their context, i.e., whether they are school-, schooling-, or broadly learning-related [1]. Goodall underlines the importance of the latter, as it allows parents to engage with their children's learning in school-independent settings and to take advantage of the strengths of natural contexts. The teacher plays a preponderant role in supporting engagement in activities that are relevant to the student's broader learning as well as in cultivating the meaningfulness of such learning in school- and schooling-related engagement [11]. Such support is better conveyed through mutually respectful parent–teacher dialogue.

Communication is necessary in parent–teacher partnerships in order to align goals. Research on parents' perspectives shows that an open line of communication between parents and teachers is viewed as an important facilitator of partnership and engagement [12] and a primary way of enhancing parents' trust in the teacher [13]. Conversely, in the context of parental engagement in homework, a lack of communication has been shown to pose serious risks to partnerships, as parents' own role in construction and beliefs about such forms of involvement may differ from teachers' expectations [4].

Accordingly, Baker and colleagues [14,15] underline the importance of teachers and schools not only communicating but also actively listening to parents. Their focus-group research with parents and teachers revealed that parents may feel distant from the teacher if proper time is not allocated to invest in dialogue. Moreover, parents may experience anger or frustration when they perceive that their initiatives to increase home–school contact are not welcomed. A further qualitative study found that parents considered the following three teacher behaviors to be essential during dialogue: taking notes, discussing next steps, and showing attention and concern [16]. Such behaviors cause parents to feel listened to and valued as assets in their children's schooling and learning [13] and legitimate their role and participation.

Research demonstrates that teachers' invitations for participation may vary according to the structural framework provided by the school, and that such invitations constitute an important element in the construction of parents' roles and their motivation to be engaged [17]. Teachers' invitations for engagement can contribute significantly to the strengthening of partnerships if parents feel their participation is worthwhile. By contrast,

studies have shown that merely visiting the school to receive a one-way report from a teacher on a child's behavior or achievement, or sitting down at home to teach homework, might negatively affect engagement and home–school partnerships [7,18]. Such a school-centered model of parental involvement poses several challenges for genuine parental engagement with learning. For parents, teachers' invitations to attend school activities might cause feelings of guilt if they are unable to do so [14], which might negatively affect the relationship with teachers.

Despite the importance of the teachers' active role in engaging parents in learning, research shows that partnering with parents and supporting their engagement is an area where teachers lack confidence and formal instruction [19,20]. The latest reports on teachers in Europe [21] show that 36 percent of teachers consider addressing parents' concerns to be a source of stress in their daily work. Studies on teacher training programs [16,22] have concluded that, in order to better facilitate children's learning, more formal instruction is required to improve the quality of teacher education regarding parent–teacher partnerships and to enhance communication with parents from diverse backgrounds. Indeed, research is calling progressively more attention to the gap between the importance teacher training programs give to the parental engagement topics and their lack of courses on the subject. These studies [9,23] underline developing partnerships with parents as a core competence of a professional teacher and family engagement as an essential component of school organization.

In this article, we study parents' perspectives on the role of teachers in supporting parental engagement and partnerships, to inform on best practices in parent–teacher partnerships and parental engagement.

1.2. Context of the study

Finland and Portugal were selected for this study because both have recently introduced important curriculum reforms with holistic pedagogical aims [24,25]. However, Finland and Portugal are implementing these holistic educational goals from different historical and cultural backgrounds. While Portugal became independent in the 12th century and later endured a dictatorship, Finland's independence began just 104 years ago, and the country has been a constitutional democracy since its inception [26,27]. Nevertheless, today, in the sphere of education, both nations share many similarities through their membership of the European Union (EU), the Organization for Economic Cooperation and Development (OECD), and the Programme for International Student Assessment (PISA). Table 1 summarizes both countries' historical backgrounds and landmarks in basic education from the 1900s to today. The early 20th century was chosen as the starting point to allow a more concise contextualization.

In Finland, the teaching profession and its socio-cultural background have grown in an iterative manner. The Lutheran moral values of Nordic societies formed the basis of teachers' roles grounded on ethics, hard-work, and independent thinking [28]. When six-year compulsory public education was introduced in 1921, teachers were already important cultural actors, had received specific education in teacher training colleges, and bore the main responsibility for increasing literacy among boys and girls [29]. In 1943, Finland was the first country in the world to introduce a law on free meals for all students [30]. Quality education for all was supported by the basic principles of a trustworthy and stable social welfare system [31]. Pioneer reforms and policy decisions resulted in nine-year compulsory basic education, gradually realized over the 1970s [32], while a five-year master's degree became a prerequisite in academic teacher education in 1979 [29]. The decentralized nature of the new educational system granted teachers autonomy to influence decisions about teaching [29]. This enhanced their prestige and social trust, increasing the competitiveness and attractiveness of the profession [29,33].

Table 1. Finnish and Portuguese historical background and landmarks in basic education.

	Finland	Portugal
Early 1900s	*Lutheran value heritage; democracy*	*Catholic value heritage; dictatorship*
	Ethical, moral, and diligent teacher; Teaches literacy, develops cultural activities; Attends teacher-training college; All children receive free education and meals in school.	Conformist, obedient teacher; Teaches respect for the nation, family, and traditions; Receives limited or no specific training; Unprivileged children are absent or drop out of school.
Late 1900s	*Social welfare system; teacher education reform*	*Rupture from the system; democracy*
	Trustworthy and stable society; Decentralized educational system; Teacher education establishes a 5-year master's degree; Teaching has high levels of attractiveness and prestige.	Revolution and rebirth of society; Centralized educational system; Teacher education differs in length and institution type; Teaching has low levels of attractiveness and prestige.
Early 2000s	*International cooperation and policies*	*International cooperation and policies*
	Common European high standards in education; Bologna Process: teachers' research-based education; PISA: Affirmation as a world reference in education; Reform of the Core Curriculum for Basic Education.	Common European high standards in education; Bologna Process: mandatory 5-year master's degree; PISA: Consistent educational growth and policy reforms; Reform for a national student-centered approach.

Today, Finnish basic education encompasses the elementary (grades 1 to 6) and lower secondary levels (grades 7 to 9). Elementary school students have one main class teacher. Finland continues to pursue high standards in education, embedded in the context of growth and principles shared with the EU and international organizations such as the OECD. Moreover, compulsory education will be extended to twelve years starting in autumn 2021 [34]. Finnish education entrenched its position as a world reference for excellence in the first decades of the 21st century [35] through the PISA reports. Even though studies on upper secondary school students and pre-service teachers reveal a slight decrease in the attractiveness of the profession, teachers are still highly regarded by society and seen as ethical, autonomous, and reflective professionals [21]. Because the National Core Curriculum for Basic Education 2014 [25] serves the teacher as a general framework in terms of learning goals, core competences, and values [35], Finnish pre-service teachers must acquire a wide variety of skills for autonomy. Such skills include high levels of content and pedagogical knowledge; social, moral, and technological knowledge; skills for research, planning, organizing, and assessment; and skills for cooperation with other teachers and with parents [35,36]. The latest reform of the Core Curriculum was introduced for grades 1 to 9 between 2016 and 2019 [25]. The changes aim to improve the already holistic educational system by increasing rich interactions within the school culture and the integration of pupils' diverse learning contexts. The curriculum focuses on developing students' transferrable skills, such as thinking and learning to learn, cultural competence, interaction, participation, and managing daily life [25].

In Portugal, a long 41-year period of dictatorship shaped the development of education and the role of teachers in society. During that period (1933–1974), the compulsory education, of four years, reflected the fascist government's set of principles, grounded in devotion to the Catholic religion and national traditions. For boys, schooling concentrated on drawing skills and manual abilities, while the education of girls focused on domestic activities and respect for family values. Moreover, textbooks were stipulated by the government, and teacher training was limited or non-existent; absenteeism and drop out levels were high among less privileged children [26].

Major reforms in the organization of schooling and curricula were introduced after the revolution and the beginning of democracy, but it was not until the 1980s that fundamental change occurred [37,38]. The curriculum and teacher education were reformed and the pedagogical and social prestige of the teaching profession started to increase [26]. Besides expanding compulsory education to nine years, the reforms aimed to guarantee all children the right to education and culture, focusing on active citizenship, equality of opportunities,

and freedom of learning and teaching [37,38]. From then until the first years of the 21st century, teacher education was nonetheless inconsistent and weakly regulated [39]. It varied from four to six years and could occur in universities, polytechnics or through less formal practical training [39].

Currently, Portuguese basic education is divided into three cycles. The first cycle refers to grades 1 to 4, the second cycle to grades 5 and 6, and the third cycle to grades 7 to 9. During the first four years, students are taught by a main class teacher. Portugal continues to strive for high standards in education and teacher training, influenced by EU policies and OECD countries. In 1999, the Bologna Process triggered the establishment of a five-year Master's degree for all teachers [39], and, in 2009, compulsory education increased to twelve years [37]. Moreover, the role of teachers became more complex, as they were expected to acquire more autonomy and reflective skills [40]. Between 2000 and 2018, Portugal consistently improved its PISA ranking regarding students' reading, math, and science skills [37]. Between 2002 and 2015, Portuguese parliamentary debates on education centered on OECD, PISA, and other international results, as well as on educationally successful nations, such as Finland, Denmark, Sweden, Germany, and the UK [41].

In 2018, Portugal implemented a reform to introduce a student-centered approach to learning, based on the principles of holistic pedagogy [24] and to increase the autonomy of schools [42]. The new documents focused on pupils' development of transferable skills, such as critical and creative thinking, interpersonal relationships, personal development, and autonomy. Early evaluations of the new system [42] underline the need to support a collaborative culture between teachers to enhance professionalism and ensure consistency between schools. They also call attention to Portugal's extremely low number of young teachers (under 30 years: 2%; over 50 years: 40%) and the fact that only 10 percent of teachers perceive their role as valued by society. It is argued that such a situation contributes to a less dynamic profession, which can directly affect the quality of the teaching workforce [42]. Another obstacle identified was the centralized nature of the system, where the government is responsible for 50 percent of management decisions related to education and 80 percent of management decisions related to personnel issues [42]. Such distant decision-making processes affect Portuguese teachers, who currently experience the highest levels of stress in Europe [21]. The source of this stress is mainly the amount of administrative work and pressure from the school's administration. Additionally, studies show that, despite efforts to implement a holistic pedagogy, the primary pedagogical method remains a theoretical explanation of content followed by consolidation exercises [43].

Despite Finland and Portugal's distinct historical backgrounds, their recent landmarks in education converge. Both wish to modernize and adapt their curricula to the current and future needs of a globalized society and make learning a more integrative process. Consequently, it is necessary to investigate the way parent–teacher partnerships are viewed in both countries.

1.3. The Role of Finnish and Portuguese Parents in Their Children's Learning

Teachers in Finland have traditionally enjoyed high levels of trust as professionals in all segments of society, including among their students' families. Cooperation with families and other community stakeholders has long been common practice and a key feature of the entire social welfare system. In the latest curriculum reform process, which lasted two and a half years, the Finnish authorities maintained open channels of communication with the community. Indeed, more than 4000 comments on the curriculum were received from organizations and individuals [44]. Additionally, only four percent of Finnish schools reported being subjected to constant pressure from parents, compared to much higher levels in other countries (e.g., Singapore, 60%; Australia, 36%) [35].

Finnish parents consider partnership with teachers a shared responsibility, essential to children's success along with active parental participation [45]. They tend to view their own and the teacher's responsibilities as complementary and rather independent of each other. Parents describe themselves as being responsible for their children's rearing

and upbringing, while teachers are seen as playing a predominantly pedagogical role. In addition, parents expect teachers to keep them informed about their children's conduct and behavioral problems at school [45].

Nevertheless, the exchange of information between teachers and parents is not entirely unproblematic. As most such communication occurs via an online platform, Wilma, teachers' written feedback might not always be perceived as encouraging by parents and thus might threaten the development of a successful partnership [46]. Finnish research on teacher education [22,47] demonstrates the importance of providing pre-service teachers with more practical training in cooperating with parents and developing cultural sensitivity in these partnerships, as the number of multicultural families has risen sharply, particularly in Helsinki metropolitan area. Parents from rural areas in Finland are more likely than urban parents to view digital communication as conducive to partnerships with teachers and to interpret online feedback as encouraging [46]. These findings indicate that more knowledge is required to strengthen parent–teacher collaboration, especially in the capital-city region.

In Portugal, the challenges to the establishment of partnerships are different and stem from a more fundamental level. For example, a school's working environment and conditions may prevent teachers from dedicating themselves to parent–teacher partnerships [21]. Cooperation with parents and other external stakeholders has emerged as one of the top ten needs of newly qualified Portuguese teachers [48].

Furthermore, current research highlights parental difficulties in partnering with teachers and engaging with learning at various levels. For instance, many parents are unable to accept teachers' invitations due to work hour constraints [49]. Parents also perceive that their involvement is limited to attendance at thematic school events [49]. Other studies suggest that visiting the school solely to receive negative feedback about their children or to attend activities with an "audience role" contribute to parents' lack of habit in cultivating school–home relations [50].

Despite these differences, the structures of the Finnish and Portuguese basic education system and current policies are sufficiently similar to allow comparison. Indeed, a recent study on the two nations [51] illuminates how teachers could approach parents' role from a holistic perspective. It demonstrates that Finnish and Portuguese parents refer to relationship- and leisure-based interactions with their children as legitimate forms of engagement with learning more often than they refer to schooling-related activities. Thus, valuable lessons on how to partner with parents and engage them with learning are likely to emerge from comparative exploratory studies between Finland and Portugal.

This study is based on the constructivist approach taken by both the Finnish and the Portuguese new curricula [24,44], according to which children's learning and knowledge are constructed instead of merely assimilated. Similarly, parent–teacher partnerships regarding children's learning are expected to develop in a constructivist manner, where their interaction and communication serve as a basis for shared knowledge and mutual support for the children's holistic development. However, and potentially because the Finnish and Portuguese new curricular guidelines are recent, how such partnerships and parental engagement are actually constructed is yet to be explored. In the Finnish case, various studies sustain a maintained tradition of co-construction of learning and learning environments between school, home, and community, in the educational system [35,36,44]. For Portugal, thorough studies regarding the curriculum guidelines and its actualization, beyond OECD studies [42], are still needed. Overall, both countries, and European nations in general, lack scientific evidence on parental engagement practices [23].

The present study explores this issue in the context of elementary school parents. More specifically, it strives to answer the following research question: "How do parents view the role of teachers in supporting parent–teacher partnerships and parental engagement in school in Finland and Portugal?".

2. Materials and Methods

2.1. Participants

This study adopted a qualitative approach based on in-depth interviews. We sent invitation e-mails to a set of 50 Finnish parents with fluent English skills who had previously collaborated with the Copernicus project, by answering a mindset survey in 2016 or 2017 [51]. In turn, the Portuguese parents received an invitation from the principal of the respective schools, and those wishing to collaborate enrolled through a hyperlink. All parents who volunteered were interviewed.

The participants (N_{Finn} = 19; N_{Por} = 9) were parents of first- to sixth-grade students from each country's capital city area: Helsinki and Lisbon. The parents signed an informed consent form and were previously informed about the interview theme [52].

In Finland, the parents came from two schools located in different socio-economic neighborhoods to ensure diversity of parental experiences and narratives. One school, with 900 students, provided basic education from grades 1 to 9, while the other, with 940 students, taught grades 1 to 12. Schools in Portugal are organized in groups (agrupamentos) of neighboring schools with complementary levels under the same administration. The Portuguese parents came from one five-school agrupamento of 2550 pupils from kindergarten to grade 12, that served a heterogeneous neighborhood.

The Finnish parents were interviewed face-to-face in February 2020, whereas the Portuguese were interviewed between March and June 2020 via the videocall software Zoom on account of the coronavirus pandemic. All necessary precautions to ensure the participants' privacy during the interviews were taken. The Finnish and Portuguese participants were interviewed in English and Portuguese, respectively.

The parents' mean age was 44 years (M_{Finn} = 47; SD_{Finn} = 9; Min_{Finn} = 40; Max_{Finn} = 70; M_{Port} = 40; SD_{Port} = 6; Min_{Port} = 29; Max_{Port} = 50). Most participants were female (N_F = 14; N_M = 5), and only one Portuguese mother, among all the parents, lacked a university degree. Ten participants were parents of first to fourth graders (N_{Finn} = 3; N_{Port} = 7), and nine had children attending grades 5 or 6 (N_{Finn} = 7; N_{Port} = 2). Three parents had an only child (N_{Finn} = 2; N_{Port} = 1), ten had two children (N_{Finn} = 3; N_{Port} = 7), and six had three children (N_{Finn} = 5; N_{Port} = 1). Of the 19 parents, two indicated facing major learning and/or behavioral struggles in their children's learning process (N_{Finn} = 1; N_{Port} = 1), and another four referred to dealing with eventual or minor struggles (N_{Finn} = 3; N_{Port} = 1). All other parents described their children's learning process as good or excellent (N_{Finn} = 6; N_{Port} = 7).

2.2. Procedure

This study's data is drawn from a broader qualitative study on parent–teacher partnerships and parental engagement. We used semi-structured interview protocol to ensure consistency, while also allowing for spontaneous narratives to emerge [53]. The interviewees were asked to speak rather freely about the topics of parental engagement with their children's learning at home and at school, including their children's challenges and successes in learning and the parent–teacher learning-related partnership. The opening question was "Please, tell me about which components, in your opinion, contribute to a successful parent–teacher partnership?" The narratives were followed by clarifying questions by the researcher, who would lead the conversation to the subsequent topic of discussion in a natural manner. Examples of such questions were "What does parental engagement with learning mean from your point of view?", "How can parents engage with learning at school?", and "How can teachers support parental engagement with learning?" The sequence of questions varied from one interview to another to promote flow and spontaneity.

The interviews varied in length from 30 to 120 min, the average length being one hour. They were audio-recorded and later transcribed, generating 213 pages of text. Before the interview, the parents also completed a short demographic questionnaire.

2.3. Analysis

Inductive content-analysis was employed to study the data. We chose this approach because it is commonly used in research aimed at enhancing understanding of and retrieving meaning from rich verbal data in an objective and systematic manner [54]. Thus, all the codes were derived from the data [55]. The unit of analysis varied from parts of sentences to whole paragraphs, the criterion for inclusion being that each coded excerpt constituted an independent element of meaning about the phenomenon [55]. The analysis was performed using Atlas.ti 8 software.

After the unit of analysis was established, the next step was to codify the data, to identify parents' perspectives on the role of teachers in partnerships and engagement. This began with the first author coding each interview. Every time a new topic on the role of teachers emerged, a new code was created. The codes were clustered into eight subcategories and later into three main categories. Then, the second author coded the interviews independently according to a shared codebook previously developed between the authors. Cohen's kappa values were calculated using SPSS 27 software to ensure inter-rater agreement regarding the main categories. The kappa values for the first, second, and third main categories were, respectively, 0.767, 0.877, and 0.748, showing a high level of agreement. Lastly, disagreements were discussed and the items in questions were jointly recoded. This process necessitated iterative analyses of the data. Example 1 demonstrates a unit of analysis related to communication, of which the code was *providing open channels of communication*, subcategory *teacher dialogues*, and main category *teacher communicates*.

Example 1: *He [the teacher] likes the presence of the parents. He is always telling us 'If you have any questions, even regarding some content of study, or some other question, no problem, just call me, I am always available. I gave you my phone number and you also have my Facebook [profile], you can always send me a message, there's no problem whatsoever'. So, he ended up making us [parents] very comfortable and opened up the door widely for that.* (Parent 6)

3. Results

The results are grouped under three main themes that correspond to the perspectives of parents about the role of teachers in partnership and parental engagement. The themes were (1) the teachers communicate, (2) the teachers show professionalism, and (3) the teachers invite active participation. Table 2 shows the frequencies of these categories and their subcategories in our data. The results are presented both from a general and a culture-specific perspective.

Table 2. Frequencies of the main categories and subcategories of parents' perspectives on the role of teachers in parent–teacher partnership and parental engagement in the school.

The Teachers Support Partnership and Parental Engagement When They	Number of Statements		
	Finnish (N = 10) *f*	Portuguese (N = 9) *f*	Total (N = 19) *f*
Communicate	**76**	**59**	**135**
Dialogue	42	34	76
Inform	26	12	38
Give pedagogical advice	7	4	11
Welcome parents' initiatives	1	9	10
Show professionalism	**44**	**24**	**68**
Have competence to teach	38	17	55
Have a good pedagogical relationship with the child	6	7	13
Invite active participation	**27**	**28**	**55**
Invite to parental activities	15	26	41
Invite to collaborative activities	12	2	14
Total of statements	**147**	**111**	**258**

3.1. Teachers Communicate

One pattern that emerged from the data was the importance parents placed on communication. Teachers' ability to **communicate** seemed to be perceived as a major boon to parental engagement and a basic element for successful parent–teacher partnerships. Such communication may take different forms. The most frequent form within our data was teachers' ability to engage in dialogue, i.e., to establish two-way communication that provides space for parents' input and possible insecurities. This mother's statement well illustrates such an ability in the form of a "no-barrier" attitude:

> The most important component is smooth communication and no barrier. Because if you don't have a barrier, you can also approach the teacher with some problematic issues, or ask for advice. . . . We are all emotional beings, and we see things in a different way, so it is important to communicate, to speak things out and to be understood. (Parent 18, Finnish, Female, 44 years old)

Additionally, of great relevance to parents was the need to be kept informed by the teacher. The parents seemed to perceive such teacher behavior as the most reliable way of monitoring their children outside the home. Nevertheless, the Finnish and Portuguese parents shared different narratives of being informed. The Portuguese parents focused more on the "remedial" role of information, such as being informed of problems or homework matters, while the Finns emphasized the importance of receiving regular information about their children's schooling. This information arrived in the form of weekly letters sent by teachers to all parents about the classroom routine of the past week and plans for the following week through the Wilma online platform. For example, one mother stated:

> It is very important information to me, because my son doesn't speak so much. I ask him how the day was, and [he answers] "it was good". I am left wondering about what is happening in real life, because I can't be there watching what's happening, so it's the only way to get the information. I like to get these emails. (Parent 10, Finnish, Female, 54 years old)

The **communication** the parents valued from teachers also came in the form of providing pedagogical advice and welcoming parents' initiatives. The former refers to specific recommendations, such as suggestions for supporting children's study at home or for visiting a certain museum exhibition. The latter relates to the establishment of a communication channel that accepts and welcomes parents' ideas and interventions at the school. Being welcomed by teachers was mentioned by almost all the Portuguese parents. These parents referred to the importance of feeling that the "school's door" was open to them, that teacher-parent face-to-face interactions were not only for exceptional circumstances, and that the teacher was able to convey that message, from the beginning.

Overall, the parents perceived parent–teacher communication as a fundamental element of parent–teacher partnerships and parental engagement. This communication encompassed both parents actively reaching out to the teacher, and teachers taking the initiative to inform, support, or reach out to parents.

3.2. Teachers Show Professionalism

The parents perceived **showing professionalism** as a key factor in their partnership and engagement. Teachers' professional competence and ability to maintain a good pedagogical relationship with students emerged as manifestations of being professional.

The parents perceived teachers as competent professionals when they noticed their children were achieving the expected learning goals and when the teacher succeeded in creating a positive classroom atmosphere, showed motivation, creativity, and dedication to teach, and responded effectively to problems such as bullying. The parents often framed the teacher's professionalism within the context of the school as an institution, revealing that they viewed this professionalism as dependent on the teachers' intrinsic and extrinsic factors. The Finnish and Portuguese parents addressed these teacher characteristics similarly in their narratives, although the Finns mentioned them more often.

The teacher–child relationship was perceived by both Finnish and Portuguese parents as a central aspect of the teacher's competence that influenced parent–teacher partnerships and parental engagement. The parents referred to the importance of feeling that their children liked their teacher, and vice-versa, and that the child was supported, encouraged, and protected by the teacher at school. The parents clearly perceived the child–teacher relationship as one of the main preconditions for an effective parent–teacher partnership. The parents also mentioned the possibility of continuous interaction over time as an important factor in the development of a good relationship between the teacher and the child and consequently with the parent. The statement below summarizes these findings:

> It is also the motivation you can see in the teacher, how dedicated they are to the class. Like, how often they change a group or school. Sometimes, if there's some trouble for the school to have a motivated teacher stay with the group for a long time, you can see that they change the teacher every half a year. But, sometimes, you have a teacher that stays for many years, and it makes a big difference to get to know the teacher. Also, that they have a long period of time with your child, so they get to know them personally and see the growth, and also have an effect on their learning skills, and if there's some problems, they can address them and see the results. (Parent 14, Finnish, Male, 43 years old)

Contrary to the previous point on teachers' ability to communicate, this pattern in the parents' narratives does not directly reflect teacher–parent interactions. Instead, it demonstrates that even when parents and teachers are not in direct contact, their relationships continue to develop while mediated by other elements. This indicates the importance of the quality of both the teaching and the pedagogical teacher–child relationship.

3.3. Teachers Invite Active Participation

A third central aspect in the parents' narratives was teachers' **invitations of active parental participation**. The parents were specifically asked about school-related engagement. Thus, it is natural that participation emerged consistently as a theme. However, it is here that the Finnish and Portuguese parents' narratives differed the most. First, the Portuguese parents mentioned active participation more often than did the Finnish parents—while the Finns focused more on teachers' **communication** and **professionalism**. Second, from the two abovementioned forms of active participation—parental activities and collaborative activities—Finnish parents referred equally to both, whereas the Portuguese focused almost solely on parental activities.

The invitations of active participation that parents considered supportive of parent–teacher partnerships and parental engagement were extremely diverse. They included attending fun family days to play sports with teachers and school staff, attending parents' association meetings to organize future events, visiting the classroom to explain their professions to the children or to perform a reading, visiting the school to bake a cake with the children, watching the children perform in a musical event or performing with the children, and supporting a school's project from home by fundraising or sewing accessories for the school's carnival parades.

The Finnish parents illustrated their active participation in parental activities largely by referring to attending parents' association meetings mediated and organized by the teacher, where the parents would arrange the annual spring gathering and some other events. They also mentioned visiting the school to watch their children perform in a musical event—normally, at the spring gathering they had arranged—or to perform with the children, as, for example, in a Finnish-language poetry reading. It was evident from the Finnish parents' narratives that they were unaccustomed to visiting the school premises frequently for parental activities. When they did, these activities were normally intended to encourage parents' participation in the children's learning (e.g., a poetry reading together as part of curriculum realization), or to support parents' social interactions with each other, as stated by this father:

> All the activities where my engagement is bigger is organizing, with other parents, all these activities besides school. It's about social engagement with other parents. The way the teacher has managed that is really good. She took a very big responsibility, kind of drew all the parents in. We have this small group of parents who organize this event in the spring, kevätkeikaus. It's kind of a big event, a lot of parents go there and all different classes that they [the school] have. So, the teacher took care of the responsibility and let us do that, and we just did it. And it's good we have those, because it is not only about having a relationship with the teacher, but socializing, having this relationship with the other parents. (Parent 12, Finnish, male, 41 years old)

In the case of the Portuguese parents, parental activities, common throughout the school year, seemed to create a setting where the school community could gather, relax, and enjoy some time together, i.e., where community interaction could extend beyond schooling matters. Elements of the child–parent relationship were also present in the Portuguese parents' statements, although less frequently. Moreover, despite perceiving parental activities as supportive of partnerships and parental engagement, the Portuguese parents also seemed to view them as somewhat of a burden, given that the school day finished at around five o'clock and most parents' working day ended around the same time or later. This is indicated in the following statement from a mother:

> Of course, it is very nice to gather together and to know each other and to go there [to the school] to do something, to play. . . . That "family day" where we were all together, with the teacher, with all the children. . . . Well, yeah, two or three times a year I think is enough. As long as, in the background, there is continuous interaction, and communication and team work [with the teacher]." (Parent 4, Portuguese, Female, 40 years old)

Collaborative teacher–parent activities were seldom mentioned by the Portuguese parents as a form of school-related active participation. The exceptions were two statements about the importance of being invited to less rigid school projects that allowed parents' creativity in their participation and of being invited to face-to-face meetings with the teacher. By contrast, face-to-face meetings with the teacher were very frequently mentioned by the Finnish parents as a form of school-related collaborative active participation that legitimated the parents' role. Even though the Finns reported attending such meetings only once or twice a year—given that most of the interaction occurred online—they referred to these as key moments not only for the partnership between parents and teachers but also between parents, teachers, and children. They also remarked on their satisfaction with this pattern of interaction. As one father explains:

> This meeting is only with the child and the teacher, concerning the kid, where teachers usually have some documents that parents filled in, where they asked questions about how we feel about how the schooling is going. And we can help with that document. We talk with the child, go through how the progress is going, and then we give the papers to the teacher before (the meeting). And we talk with the teacher if they agree, if there's some issue, things the child studied that are too easy or too difficult, that they can try to adjust or think of how to make it better. And also, for us, it's good for us to know if the child is keeping up, because the amount of learning is quite a lot. . . . Often I think children have some subjects they don't like so much and they might not learn as quickly as they should, and we can discuss those things with the teacher on that meeting. (Parent 14, Finnish, Male, 43 years old)

In general, the parents' school-related active participation occurred in both parental activities and collaborative activities with the teacher. However, distinct differences between Finnish and Portuguese in-school participation were evident. In the Portuguese context, teachers tended to invite parents to participate in activities throughout the school year—activities which were often unconnected to the children's learning goals and that

may be demotivating to parents after a long day at work. In the Finnish context, teachers invited parents to specific collaborative goal-oriented occasions regarding the children's learning progress and future—occasions where not only the parents but also the children participated.

4. Discussion

In this article, we set out to explore parents' views on teacher support for parent–teacher partnerships and parental engagement from a qualitative standpoint. We also looked further into differences and similarities between Finnish and Portuguese parents' narratives. Here, we followed Janet Goodall's framework of parental engagement and parent–teacher partnerships. We analyzed, by means of inductive content analysis, individual interviews of 19 parents of elementary school children.

In this study, we identified several attributes, within the role of teachers, that were perceived by parents as supportive of a successful parent–teacher partnership and of parental engagement with the school. In particular, these attributes concerned teachers' ability to communicate, to show professionalism, and to invite active participation in the school. Our findings align with previous research that demonstrates the importance parents place on parent–teacher communication [12,13] and teachers' ability to engage in dialogue [14–16] for the development of partnerships and parental engagement. Our results also confirm previous research showing the positive impact of meaningful invitations on role construction and parental motivation to engage with their children's schooling [4,17]. Additionally, the present findings, along with our previous research on parental engagement in the home [51], demonstrate the applicability of Goodall's framework of parental engagement and parent–teacher partnership. In the holistic pedagogical contexts of our participants, all the components of this framework contributed to successful partnerships and engagement: dialogue, legitimation of parents' role, and invitations to meaningful participation [1,11]. In this study, these factors were revealed in the form of teachers' communication, professionalism, and invitations to active participation.

Within these categories, the parents' narratives nevertheless revealed country-specific differences, likely embedded in their historical and cultural backgrounds. Despite identifying similar ways of perceiving teacher support, the parents' descriptions often differed, both in frequency and in meaning. The Finnish parents' perspectives formed a picture of parent–teacher partnerships and engagement with the school grounded in little face-to-face contact but consistent communication. This pattern aligns with previous research, as the simplicity and relative infrequency of parent–teacher interactions seem to be supported by the parents' view that their responsibilities and those of the teachers are complementary but independent, and that home and school are perceived as serving different purposes [45]. Their sense of teachers' professionalism is gleaned through weekly letters via Wilma and annual or biannual meetings, as well as through their children's achievement and well-being. This means of communicating with the teacher was viewed positively by our urban Finnish parents. Thus, this finding has partially contradicted previous research indicating that rural parents are more likely than urban parents to perceive digital communication with the teacher as conducive to partnerships [46]. In this study, the Finnish parents indicated that regular Wilma messages helped not only to keep them informed about their children and their children's environment but also to create a sense of predictability and flow in parent–teacher communication. Consequently, parents seemed to feel little need for face-to-face encounters with the teacher. According to the parents' narratives, neither they nor the teachers seem to ask "too much" from each other, and all extra requests from teachers were seen as clearly optional or respectfully negotiated. The Finnish parents' narratives conveyed the idea that "less is more" and demonstrated trust in the teacher and the educational system. Traditionally, the professional competence of teachers has been universally recognized by Finnish society and seen as an intrinsic part of becoming a teacher [29,33,35]. Overall, Finns exhibit relatively strong trust in the various strands of the social welfare system [28], including public schools and teachers. For Finnish parents, belief

in teachers' competence to teach and to build a relationship with their children constitutes a strong foundation for parent–teacher partnerships. Our interviews with Finnish parents indicated that trust in teachers' ability to perform their work exceptionally well seemed to enable both effective communication and active parental collaborative participation.

Our Portuguese parents', by contrast, expressed more complex perspectives on their partnerships and school-related engagement. The parents' narratives revealed a conceptualization of partnerships and engagement grounded in rather frequent—and largely face-to-face—parent–teacher interaction. Moreover, the responsibility for building this partnership seemed to rest heavily with teachers, specifically in their invitations for participation in recreational activities. In general, the parents reported enjoying visits to their children's school space and contact with teachers in a more informal setting. This finding contradicts previous research suggesting that Portuguese parents feel they are invited to school primarily to receive negative feedback about their children [50]. Nevertheless, the parents in our study sometimes found it challenging to fit parental school activities into their busy and long working hours. These findings are in line with those of Bento et al. [49]. In addition, the parents conveyed the idea that some school-related activities, mainly those where they played the role of spectator, were unmotivating, which confirms previous research findings [50]. Like their Finnish counterparts, the Portuguese parents perceived the idea of simplicity in parent–teacher partnerships and parental engagement as supportive and valued continuous communication over sporadic interaction. Nonetheless, these were not seen as common features of the present Portuguese system. Beyond visits to the school, parent–teacher communication varied widely, i.e., it differed from parent to parent in the same school or classroom. This can be partially explained by the current context of the Portuguese educational system, where teachers are highly stressed, must dedicate a large amount of time to administrative work, and are obligated to implement curriculum changes decided by central government [21,42]. Such time constraints can also be the reason parents perceived their communication with teachers as focusing primarily on problems to be solved. On the other hand, according to the parents' narratives, it was just these challenging situations that brought teachers and parents closer together. The parents described teachers as being responsive to their requests for help and advice, which played a major role in their partnership, as they felt that teachers were willing to meet them as often as necessary. In a challenging context where teachers' schedules can be chaotic, teachers' readiness to find time to invite parents to the school and listen to their concerns earned the sincere appreciation of parents. Such findings align with previous research [14,15] about the importance of teachers' time dedication to parents in building their partnerships.

Overall, despite the Portuguese context presenting a more challenging setting for parent–teacher partnerships, this study provides exemplar practices for cultivating effective partnerships and engaging parents in school in both countries. In Finland, such practices include regular communication, which can be supported by digital tools, as well as one or two meetings oriented to discussing students' learning milestones—respecting the schedules of both parents and teachers. In Portugal, these practices involve responding to and providing space for parents' requests for face-to-face meetings, which enable real-time dialogue and the development of proximity between teachers and parents.

This study provides detailed descriptions of the way parents perceive and experience teachers' support for partnership and engagement. The current demands in education can cause future teachers to experience insecurity about their own abilities to partner with parents and engage them in learning [20,22]. Our results help to inform the implementation of a holistic pedagogy coherent with the Finnish and Portuguese new curricular goals [24,25] by presenting concrete samples of teacher's practices in parent–teacher partnerships. Moreover, they help dispel the recurrent belief that dealing with families is highly challenging.

Two key findings of this study could serve to guide early career teachers' interaction with parents. The first is the central importance of keeping parents informed. Weekly information from the teacher about their children group's accomplishments, routine, and planned activities establishes a predictable rhythm to the communication and is apt to make parents feel engaged and considered. Such information may be short and simple, but it nevertheless establishes an important dynamic where parents perceive they are part of their children's education—even when this occurs online. The second, regarding invitations of active participation, is the importance of inviting parents to cooperative and periodical events at the school, instead of inviting to recurrent, parents-only activities. Invitations to cooperation at the school could focus on goal-oriented tasks directly related to the student's progress. In addition, one or two recreational activities a year can support the improvement of the parent-teacher partnership and the building of a sense of community within the school. Such activities, focused more on parents than on parent–teacher cooperation, might be more likely to support the partnership when they have a meaningful purpose, e.g., are connected to the curriculum aims. Above all, it is necessary to maintain an open channel for dialogue and to listen to parents' requests, as they are likely to differ from person to person.

This study nevertheless contains limitations concerning the background of our participants. It is important to acknowledge that, with the exception of one parent, all participants had a university degree. Thus, the sample was insufficiently heterogeneous to ensure the generalizability of the findings. Consequently, our results must be interpreted within the context of highly educated parents. Additionally, among our participants, two Portuguese parents had children attending grades 5 and 6. This constitutes a limitation because the structure of teaching in these grades differs between Finland and Portugal. In Portugal, starting in grade 5, pupils are taught by a variety of subject teachers, and they begin to have a more compartmentalized timetable, which poses additional challenges to partnerships and parental engagement. In terms of methodology, one limitation of our individual in-depth thematic interviews was that the Finnish parents were not interviewed in their native language. Although all the parents spoke English fluently, some were more comfortable than others with talking in a foreign language, which may have prevented them from exploring some interview topics more deeply. It is also important to refer that differently posed interview questions could have originated different findings, as we aimed to explore best practices and therefore focused our questions on successful partnerships. Nonetheless, despite its limitations and constraints, this study possesses considerable strengths, such as a qualitative design that provides rich descriptions of the participants' experiences and meaning-making in their own words. Such individualization is one of the most salient advantages of conducting qualitative research [55]. Even though we recognize the non-generalization of the results from a cross-cultural standpoint, we believe that both general and cultural-specific findings shed new light and bring forward relevant insights regarding parental engagement in school and parent–teacher partnerships to Finnish, Portuguese, and other holistic educational systems.

We recommend that future studies on this topic explore more diverse settings, interviewing parents from immigrant backgrounds and various socio-economic groups. In addition, it would be important to describe teachers' perspectives on the same topics.

Author Contributions: Conceptualization, C.L., E.K., K.T.; methodology, C.L., E.K., K.T.; software, C.L.; validation, E.K.; formal analysis, C.L., E.K.; writing – original draft, C.L.; writing—review and editing, E.K., K.T.; supervision, E.K., K.T.; project administration, K.T.; funding acquisition, C.L., E.K., K.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded the Finnish Agency for Education (EDUFI: TM-19-11247).

Institutional Review Board Statement: The study was conducted according to the guidelines of The Finnish Advisory Board on Research Integrity.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors upon request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Goodall, J. Learning-centred parental engagement: Freire reimagined. *Educ. Rev.* **2018**, *70*, 603–621. [CrossRef]
2. Stroetinga, M.; Leeman, Y.; Veugelers, W. Primary school teachers' collaboration with parents on upbringing: A review of the empirical literature. *Educ. Rev.* **2019**, *71*, 650–667. [CrossRef]
3. Cankar, F.; Deutsch, T.; Kolar, M. Teachers and parents-partners with different expectations. *Int. J. Parents Educ.* **2009**, *3*, 15–28.
4. Deslandes, R.; Rousseau, N. Congruence between teachers' and parents' role construction and expectations about their involvement in homework. *Int. J. Parents Educ.* **2007**, *1*, 108–116.
5. OECD. The Future of Education and Skills: Education 2030. Available online: http://www.oecd.org/education/2030/E2030PositionPaper(05.04.2018).pdf (accessed on 2 March 2021).
6. Epstein, J. *School, Family and Community Partnerships–Preparing Educators and Improving Schools*; Westview Press: Boulder, CO, USA, 2011.
7. Hoover-Dempsey, K.V.; Walker, J.M.T.; Sandler, H.M.; Whetsel, D.; Green, C.L.; Wilkins, A.S.; Closson, K. Why do parents become involved? Research findings and implications. *Elem. Sch. J. Miedel Reynolds* **1999**, *106*. [CrossRef]
8. Levinthal, C.; Kuusisto, E. Parental engagement in children's learning: A holistic approach to teacher-parents' partnerships. In *Pedagogy in Basic and Higher Education: Current Developments and Challenges*; Tirri, K.M., Toom, A., Eds.; IntechOpen: London, UK, 2020; pp. 203–219. [CrossRef]
9. Epstein, J.L. School, family, and community partnerships in teachers' professional work. *J. Educ. Teach.* **2018**, *44*, 397–406. [CrossRef]
10. Goodall, J. Parental engagement to support children's learning: A six point model. *Sch. Leadersh. Manag.* **2013**, *33*, 133–150. [CrossRef]
11. Goodall, J.; Montgomery, C. Parental involvement to parental engagement: A continuum. *Educ. Rev.* **2014**, *66*, 399–410. [CrossRef]
12. White, C.P.; Levers, L.L. Parent-teacher engagement during child-centered pedagogical change in elementary school. *Child. Sch.* **2017**, *39*, 15–23. [CrossRef]
13. Adams, K.S.; Christenson, S.L. Trust and the family-school relationship examination of parent-teacher differences in elementary and secondary grades. *J. Sch. Psychol.* **2000**, *38*, 477–497. [CrossRef]
14. Baker, A. Improving parent involvement programs and practice: A qualitative study of parent perceptions. *Sch. Community J.* **1997**, *7*, 9–35.
15. Baker, T.; Wise, J.; Kelley, G.; Skiba, R. Identifying barriers: Creating solutions to improve family engagement. *Sch. Community J.* **2016**, *26*, 161–184.
16. McNaughton, D.; Hamlin, D.; McCarthy, J.; Head-Reeves, D.; Schreiner, M. Learning to listen: Teaching an active listening strategy to preservice education professionals. *Top. Early Child. Spec. Educ.* **2008**, *27*, 223–231. [CrossRef]
17. Whitaker, M.; Hoover-Dempsey, K. School influences on parents' role beliefs. *Elem. Sch. J.* **2013**, *114*, 73–99. [CrossRef]
18. Moroni, S.; Dumont, H.; Trautwein, U.; Niggli, A.; Baeriswyl, F. The need to distinguish between quantity and quality in research on parental involvement: The example of parental help with homework. *J. Educ. Res.* **2015**, *108*, 417–431. [CrossRef]
19. Leenders, H.; Jong, J.; Monfrance, M.; Haelermans, C. Building strong parent–teacher relationships in primary education: The challenge of two-way communication. *Camb. J. Educ.* **2019**, *49*, 519–533. [CrossRef]
20. Meehan, C.; Meehan, P.J. Trainee teachers' perceptions about parent partnerships: Are parents partners? *Early Child Dev. Care* **2018**, *188*, 1750–1763. [CrossRef]
21. Eurydice/European Commission/EACEA. *Teachers in Europe: Careers, Development and Well-Being*; Eurydice Report; Publications Office of the European Union: Luxembourg, Luxembourg, 2021. [CrossRef]
22. Alanko, A. Preparing pre-service teachers for home–school cooperation: Exploring Finnish teacher education programmes. *J. Educ. Teach.* **2018**, *44*, 321–332. [CrossRef]
23. Thompson, I.; Willemse, M.; Mutton, T.; Burn, K.; De Bruïne, E. Teacher education and family–school partnerships in different contexts: A cross country analysis of national teacher education frameworks across a range of European countries. *J. Educ. Teach.* **2018**, *44*, 258–277. [CrossRef]
24. Direção-Geral de Ensino (DGE). Perfil dos Alunos à Saída da Escolaridade Obrigatória. 2017. Available online: https://dge.mec.pt/sites/default/files/Curriculo/Projeto_Autonomia_e_Flexibilidade/perfil_dos_alunos.pdf (accessed on 10 February 2021).
25. Finnish National Board of Education (FNBE). *National Core Curriculum for Basic Education 2014*; Finnish National Board of Education Publications: Helsinki, Finland, 2016.
26. Campos, B.P.; Menezes, I. Personal and social education in Portugal. *J. Moral Educ.* **1996**, *25*, 343–357. [CrossRef]
27. Sinnemäki, K.; Nelson, R.; Portman, A.; Tilli, J. The legacy of lutheranism in a secular nordic society: An introduction. In *On the Legacy of Lutheranism in Finland: Societal Perspectives*; Sinnemäki, K., Portman, A., Tilli, J., Nelson, R.H., Eds.; Finnish Literature Society: Helsinki, Finland, 2019; pp. 9–36.

28. Niemi, H.; Sinnemäki, K. The role of lutheran values in the success of the Finnish educational system. In *On the Legacy of Lutheranism in Finland: Societal Perspectives*; Sinnemäki, K., Portman, A., Tilli, J., Nelson, R.H., Eds.; Finnish Literature Society: Helsinki, Finland, 2019; pp. 113–127.
29. Tirri, K. The last 40 years in Finnish teacher education. *J. Educ. Teach.* **2014**, *40*, 1–10. [CrossRef]
30. Sarlio-Lähteenkorva, S.; Manninen, M. School meals and nutrition education in Finland. *Nutr. Bull.* **2010**, *35*, 172–174. [CrossRef]
31. Mangeloja, E. Religious Revival Movements and The Development of The Twentieth-Century Welfare-State in Finland. In *On the Legacy of Lutheranism in Finland: Societal Perspectives*; Sinnemäki, K., Portman, A., Tilli, J., Nelson, R.H., Saarikivi, J., Hagman, P., Valaskivi, K., Eds.; Finnish Literature Society: Helsinki, Finland, 2019; pp. 220–236.
32. Statistics Finland. Education in Finland: More Education for More People. 2007. Available online: https://www.stat.fi/tup/suomi90/marraskuu_en.html (accessed on 20 March 2021).
33. European Commission. *Study on Policy Measures to improve the Attractiveness of the Teaching Profession in Europe*; Publications Office of the European Union: Luxembourg, Luxembourg, 2013; Volume 2. [CrossRef]
34. Ministry of Culture and Education (MEC). To all 9th Grade Students and Their Parents or Guardians. 2021. Available online: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162875/MoEC_compulsory%20educaton.pdf?sequence=1&isAllowed=y (accessed on 12 March 2021).
35. Niemi, H.; Lavonen, J.; Kallioniemi, A.; Toom, A. The role of teachers in the finnish educational system. In *The Teacher's Role in the Changing Globalizing World: Resources and Challenges Related to the Professional Work of Teaching*; Niemi, H., Toom, A., Lavonen, J., Eds.; Brill Sense: Leiden, The Netherlands, 2018; pp. 47–61. [CrossRef]
36. Lavonen, J. Educating Professional Teachers in Finland through the Continuous Improvement of Teacher Education Programmes. In *Contemporary Pedagogies in Teacher Education and Development*; Weinberger, Y., Libman, Z., Eds.; IntechOpen: London, UK, 2018; pp. 3–22. [CrossRef]
37. Marôco, J. Portugal: The PISA Effects on Education. In *Improving a Country's Education*; Crato, N., Ed.; Springer: Cham, Switzerland, 2021. [CrossRef]
38. Sarmento, T. (Re)pensar a interacção escola-família. [(Re)think the school-family interaction]. *Rev. Port. Educ.* **2005**, *18*, 53–75.
39. Pintassilgo, J.; Oliveira, H. A formação inicial de professores em Portugal: Reflexões em torno do atual modelo. [Teacher early training in Portugal: Reflections about the current model]. *Rev. Contemp. Educ.* **2013**, *8*, 24–40.
40. Sousa-Pereira, F.; Leite, C. Students profile leaving compulsory education, policy and challenges for teacher training. *Rev. Educ. Ciência E Cult.* **2019**, *24*, 113–122. [CrossRef]
41. Santos, I. Epistemic work in Portuguese parliamentary education debates: Externalisation to world situations as a source of epistemic capital. *Eur. Educ. Res. J.* **2021**, 1–21. [CrossRef]
42. OECD. Curriculum Flexibility and Autonomy in Portugal–An OECD Review. 2018. Available online: http://www.oecd.org/education/2030/Curriculum-Flexibility-and-Autonomy-in-Portugal-an-OECD-Review.pdf (accessed on 2 March 2021).
43. Leite, C.; Fernandes, P.C. National curriculum vs curricular contextualisation: Teachers' perspectives. *Educ. Stud.* **2020**, *4*, 259–272. [CrossRef]
44. Lähdemäki, J. Case study: The Finnish national curriculum 2016—A co-created national education policy. In *Sustainability, Human Well-Being, and the Future of Education*; Cook, J., Ed.; Palgrave Macmillan: Cham, Switzerland, 2019. [CrossRef]
45. Böök, M.L.; Perälä-Littunen, S. Responsibility in home-school relations-Finnish parents' views. *Child. Soc.* **2014**, *29*, 615–625. [CrossRef]
46. Kuusimäki, A.-M.; Uusitalo-Malmivaara, L.; Tirri, K. Parents' and teachers' views on digital communication in Finland. *Educ. Res. Int.* **2019**, 1–7. [CrossRef]
47. Niemi, H. Teacher professional development in Finland: Towards a more holistic approach. *Psychol. Soc. Educ.* **2015**, *7*, 279–294. [CrossRef]
48. Harju, V.; Niemi, H. Newly qualified teachers' needs of support for professional competences in four European countries: Finland, the United Kingdom, Portugal, and Belgium. *CEPS J.* **2016**, *6*, 77–100.
49. Bento, A.; Mendes, G.; Pacheco, D. 5th Iberic-American Congress in Qualitative Research. 2016. Available online: http://proceedings.ciaiq.org/index.php/ciaiq2016/article/view/648/637 (accessed on 5 March 2021).
50. Sousa, M.; Sarmento, T. Escola–família-comunidade: Uma relação para o sucesso educativo. [School-family-community: A relationship for the educational success]. *Gestão E Desenvolvimento* **2010**, *17*, 141–156. [CrossRef]
51. Levinthal, C.; Kuusisto, E.; Tirri, K. How Finnish and Portuguese parents' implicit beliefs actualize at home. *Front. Educ.* **2021**, *6*, 1–15. [CrossRef]
52. Finnish Advisory Board on Research Integrity. Ethical Principles of Research in the Humanities and Social and Behavioural Sciences and Proposals for Ethical Review. 2009. Available online: https://www.tenk.fi/en/ethical-review-in-human-sciences (accessed on 10 February 2021).
53. Legard, R.; Keegan, J.; Ward, K. In-depth Interviews. In *Qualitative Research Practice*; Richie, J., Lewis, J., Eds.; Sage: London, UK, 2003; pp. 139–168.
54. Krippendorf, K. Reliability in content analysis: Some common misconceptions and recommendations. *Hum. Commun. Res.* **2004**, *30*, 411–433. [CrossRef]
55. Elo, S.; Kyngäs, H. The qualitative content analysis process. *J. Adv. Nurs.* **2008**, *62*, 107–115. [CrossRef]

education sciences

MDPI

Article

Predictors of Parental Contentment with the Amount of Encouraging Digital Feedback from Teachers in Finnish Schools

Anne-Mari Kuusimäki *, Lotta Uusitalo and Kirsi Tirri

Faculty of Educational Sciences, University of Helsinki, Siltavuorenpenger 5 A, 00100 Helsinki, Finland; lotta.uusitalo@helsinki.fi (L.U.); kirsi.tirri@helsinki.fi (K.T.)
* Correspondence: anne-mari.kuusimaki@helsinki.fi

Abstract: The Finnish National curriculum obligates teachers to give parents encouraging feedback about their children's learning and development, the aim being to build a constructive relationship between homes and schools and to encourage close collaboration among all parties. Teachers in Finland nowadays use digital platforms that allow effective online communication. The frequency and quality of such communication vary a great deal. In particular, there seems to be a lack of clarity concerning the amount of encouraging feedback delivered in this way. The focus in this paper is on the extent to which Finnish parents (N = 1117) in both urban and rural areas are content with the amount of such feedback. We carried out a logistic regression analysis to predict parental contentment with the amount of encouraging messaging, with the pupil's grade level, parental attitudes to digital communication, as well as parental educational level and gender as independent variables. In sum, parents who were less highly educated, with a neutral-to-positive attitude to digital communication and with a child in lower secondary school were most likely to be content with the amount of communication. These results have both research and practical implications in terms of enhancing the understanding of how best to deliver encouraging digital feedback between homes and schools. Furthermore, it seems that teacher education should focus on communicative competence early on. The current study completes our three-part series of studies on digital home–school communication in Finland.

Keywords: home–school partnership; Finnish schools; encouraging digital feedback; digital communication; teacher education

Citation: Kuusimäki, A.-M.; Uusitalo, L.; Tirri, K. Predictors of Parental Contentment with the Amount of Encouraging Digital Feedback from Teachers in Finnish Schools. *Educ. Sci.* **2021**, *11*, 253. https://doi.org/10.3390/educsci11060253

Academic Editor: James Albright

Received: 5 April 2021
Accepted: 17 May 2021
Published: 22 May 2021

1. Introduction

According to the Finnish National Core Curriculum for Basic Education (grades 1 to 9) [1], frequent encouraging feedback from teachers enhances pupils' learning by creating an appreciative and motivating learning environment. Feedback should be realistic, versatile and non-oppressive. Teachers in Finnish schools are obligated to give encouraging feedback to their pupils, and close collaboration between schools and homes is expected. In fact, the Finnish National Core Curriculum for Basic Education instructs schools to send parents 'supportive and positive messages about their child's learning and development' [1]. The aim of this study is to deepen the understanding about what constitutes encouraging feedback, and more precisely, to find out what factors predict parental views on the amount of encouraging digital feedback they receive.

Positive feedback propels human actions. It generates the energy and motivation to pursue goals and carry on even in the face of adversity. In particular, encouraging feedback provided by a positive authority could be a true game-changer [2], whereas motivational opportunities may be missed if such feedback is given sparingly. Digital communication (DC) is the most common way of managing home–school collaboration in Finland, offering a multitude of opportunities to share positive messages and to give motivational feedback. However, informative issues seem to dominate the contents of DC [3]. This finding was

supported in our earlier study on parental experiences of DC content: informative issues about the child's studies were considered important, but encouraging feedback was also seen as one of the priorities [4,5].

The quality of any encouraging feedback matters. It should always be focused on the learning process in that non-specified person-targeted feedback could have a negative effect on learning, even if the content is positive [6–8]. Personal feedback such as 'good girl, great effort´ contains little task-related information and is rarely converted into stronger engagement, commitment to learning goals or enhanced self-efficacy [7]. Giving realistic and process-targeted feedback may help to strengthen a pupil's feelings of competence in the learning process [6,9], whereas constant negative feedback may have the opposite effect [10]. These findings are in line with our previous results concerning parental wishes about the content of digital feedback: parents appreciate versatile and realistic feedback on their children's learning, but an excess of corrective feedback could be discouraging [5].

A plenitude of previous studies indicates that collaboration between parents and teachers is effective in fostering the well-being and academic achievements of pupils [11–14]. Consequently, schools should invite parents to participate more actively in their children's studies. Encouraging digital communication could become an essential tool in the home–school partnership. Parental socio-economic background is strongly related to pupil learning outcomes [15]. Teachers should make sure that families lacking the opportunity to participate in their children's studies are engaged in collaboration. Digital communication could offer the tools to make this happen. The international study achievement assessments [16] refer to Mendel's [17] statement: 'Education is power and parents are force´: this is now more relevant than ever. Homes and schools must work together to balance socio-economic and educational inequity.

Joyce Epstein's pioneering work [11,12] on home–school partnership emphasises the importance of shared responsibility among parents, teachers and communities in taking care of pupils' education and development. Epstein's *Theory of Overlapping Spheres of Influence* establishes the importance of frequent interaction between schools and homes [11]. It is also pointed out that the more contact parents have with the school and the more involvement in their children's studies, the more likely the children are to do their homework, to succeed in tests and to develop positive attitudes towards school [18,19]. However, it is not only the quantity of contacts that enhances the home–school partnership, but also the quality of communication. Dannesboe et al. [20] showed in a recent study that home–school communication could foster anxiety and feelings of inadequacy among parents if their children were stigmatised as displaying 'constant inappropriate behaviour' [20]. Findings from studies on emotional reactions to digital feedback among pupils confirm that constant negative feedback does not serve a learning purpose, and only causes disappointment, concern and anger [21]. Schools in socio-economically distressed areas in particular seem to be contacting families about difficulties and problems more frequently than about advancements [12]. As Epstein et al. [12] point out, teachers in these areas should carefully consider the communication to make sure that it contains more feedback about pupils' successes. Moreover, negative feedback easily accumulates among pupils with special educational needs [22], who are in the greatest need of encouragement. Thus, there is a need to raise teachers' awareness of the importance of quality in the home–school partnership, and to focus on communicative competence early on in teacher education so as to engage all parents more deeply in their children's studies [23,24].

1.1. The Finnish Context

Finnish compulsory basic education comprises one-year of pre-primary schooling for six-year-olds and nine years of basic education for 7- to 16-year-olds proceeding from the primary (grades 1 to 6) to the secondary (grades 7 to 9) level. Most subjects are taught by one class teacher in grades 1 to 6, whereas a multitude of teachers give instruction in their own subjects in grades 7 to 9 [25]. All teachers have a Master's degree [26], and they are responsible for giving low-threshold support to pupils who struggle in their

learning. The Finnish government has recently launched a reform to extend compulsory and free-of-charge education up to the age of 18, the aim being to raise Finland's general level of education, and to foster equality and non-discrimination [27].

Home–school collaboration has not always been very active in Finland. Teachers were supposed to do their share in schools, and parents to do theirs in the home [28]. There has been extensive discussion in recent decades about the boundaries of responsibility in bringing up and educating children [29]. The revised National Core Curriculum for Basic Education [1] places more emphasis on the role of parents in their children's schooling, obligating them to take an active role in their children's studies during their years of compulsory basic education. Correspondingly, schools are responsible for teaching their pupils, enhancing the home–school partnership and supporting parents on matters concerning their children's studies [1].

At least 95 percent of Finnish schools have a digital communication (DC) platform. One pupil may have several teachers even in grades 1 to 6, and digital platforms have been used to facilitate feedback from all teachers. Indeed, DC has enabled frequent and effective two-way communication and feedback between parents and teachers [4]. In addition to giving feedback, teachers use DC to inform parents and pupils about timetables, exams, events in school and other current issues [4]. In other countries, DC has been shown to offer several benefits in home–school collaboration [30–32]. In Finland, many DC messages comprise predefined 'quick-markings', which are short notes about forgotten items, schoolwork or behaviour-related matters, for example. The selection of predefined quick-markings has been supplemented with positive remarks in many Finnish municipalities because of the public discussion about a negative corrective bias in home–school communication [33]. Pupils are usually given access to a home–school DC platform in the fourth grade, so that they can read the information notices and the teachers' quick-markings. The number and nature of DC messages seems to change in the transition to lower secondary school: it was shown in a recent Finnish study that pupils in grades 7 to 9 were more likely than younger pupils to receive encouraging teacher feedback via DC [33–35].

Gender equality is at a high level in Finland compared to many other countries. Men and women both need to negotiate the work–life balance, and they are supposed to share household chores [36]. The provision of services in the early childhood education and care sector has made it possible for mothers to go to work relatively soon after childbirth. Family-friendly policies further support fathers wishing to take paid family leave [37,38]. Gender equality has also given mothers and fathers the opportunity to share the responsibility for taking care of their children's studies and communication with school.

Digital two-way communication allows schools to give both parents equal opportunities in terms of being involved in home–school collaboration. Digital platforms may also benefit the partnership among parents who cannot easily get to the school or do not wish to talk on the phone [32]. Hence, DC serves to increase equity in home–school communication [12]. This is the case in Finland, too.

In addition to promoting family-friendly policies, the Finnish government has emphasised the goal of *equal opportunities and high-quality education for all*. It has raised the educational level in the country in recent decades. Currently, 32 percent of over-15-year-olds with a Finnish background have a tertiary-level education, and 74 percent of this population has at least a higher-secondary-level education. On the other hand, 12 percent of women and 18 percent of men with a Finnish background only completed lower-secondary education (age group 30 to 34). The educational level has risen mainly as a result of women pursuing higher education: 48 percent of women aged 30 to 34 have a tertiary-level education, the corresponding proportion for men being 33 percent [39]. Moreover, a majority of teachers in Finnish schools are highly educated women [26].

1.2. The Current Study

Digital communication (DC) in Finland has facilitated frequent and effective two-way communication and feedback between teachers and parents [4,5]. However, the quality and quantity of teacher feedback varies a lot, as do parental *experiences* of received feedback [22,32]. The same message may be understood very differently depending on the expectations and overall attitudes to school and digital communication. More research is needed to shed more light on the nature of digital home–school communication and to develop common practicalities.

The current study completes our three-part series of studies on digital home–school communication in Finland. In the first study we used a new, specially designed 14-item digital communication scale [4] to elicit the opinions of parents (N = 1123) and teachers (N = 118) on digital communication. The second study clarified the wishes of parents and teachers regarding the content of digital messages [5] The current study analyses the responses of parents (N = 1117) to questions concerning their contentment with the amount of encouraging digital feedback.

According to the results of our first two studies, parents and teachers are generally satisfied with the communication, which they perceive as supporting the parent–teacher partnership and providing valuable information on pupil development and study issues. However, the parents felt that the feedback they received about their children was less encouraging than the teachers thought it was. In particular, there was wide variance in the parents' responses concerning *the amount* of encouraging feedback in the DC messages [5]. Thus, there seemed to be discrepancy between the teachers' intentions and the parents' understanding of the message content.

We firmly believe that encouraging digital feedback could enhance the home–school partnership by encouraging different kinds of families to participate more actively in their children's studies [11]. We therefore perceive a need to enhance understanding of the factors that predict parental contentment with the amount of encouraging digital feedback. In the present study, we define encouraging digital feedback as information about *the child's successes and strengths*, as suggested in the Finnish National Core Curriculum for Basic Education [1]. Specifically, we analyse the explanatory factors regarding contentment with the amount of feedback using the previously extracted factor *Encouraging feedback* as the dependent variable [Digital Communication Scale with a three-factor structure, 4]. Pupil grade level, parental attitudes towards digital communication, education and gender were selected as independent variables.

We addressed the following three research questions to find out which factors predict contentment with the amount of encouraging digital teacher feedback among Finnish parents:

1. How content are the parents of pupils in primary and lower secondary school with the amount of encouraging digital feedback?

2. How content are parents with the amount of encouraging digital feedback depending on their attitudes to digital communication?

3. How content are parents with the amount of encouraging digital feedback depending on their educational level?

2. Materials and Methods

The data collection took place in 2016. The participants were 1123 voluntary, anonymous parents (79.8% mothers, 18.5% fathers, 1.7% did not mention their role) from one urban and one rural city in Finland. We sent an informative email to the educational authorities in the cities, who then delivered invitations to the school principals to participate in the study. The principals forwarded the link to our questionnaire to parents via a commonly used DC platform. The recruitment of particpants is explained in more detail in our previous studies [4].

The questionnaire comprised the digital communication scale and several background variables, also reported in more detail in our previous studies [4,5]. The background

variables in the current study were the pupil's school grade level, the parents' attitudes to digital communication, and parental educational level and gender (see Table 1). The children of the participating parents were in primary (63%) or lower-secondary (37%) school. Overall parental attitude was assessed on a single question: 'What is your first reaction when you receive a digital message from the school?´ The overwhelming majority of parents (84%) reported a first reaction that was not negative (neutral, 15.8%; appropriate interest, 64.8%; and delight, 3.4%). These respondents were categorised as having a neutral-to-positive attitude. Parents with a higher educational level were overrepresented (58%) (Table 1).

Table 1. The recoding of the parental background variables.

1. Child's grade level 1st to 6th *7th to 9th*	→	1. primary school *2. lower secondary school*
2. Parental attitude to DC a. neutral b. appropriate interest c. delight *d. concern* *e. irritation*	→ →	1. positive/neutral *2. negative*
3. Educational level a. lower secondary education or less b. upper secondary education c. lowest level tertiary education *d. bachelor or equivalent level* *e. polytechnic education* *f. university*	→ →	1. lower education *2. higher education*
4. Gender		1. female *2. male*

The respondents could choose not to answer any specific question. Only six of the original 1123 participants did not respond to every item of the encouraging feedback factor, and they were removed from the study. Thus, the final number of participants was 1117.

In the current study, we followed the guidelines of the Finnish Advisory Board on Research Integrity [40] with regard to participant selection, data collection, and the analysis and interpretation of the results.

Data Analysis

In our previous study [4], we found three items from the 14-item digital communication scale that were loaded on the *Encouraging feedback* factor, which were rated on a four-point scale (1 = strongly disagree, 2 = disagree somewhat, 3 = agree somewhat, 4 = strongly agree). In that particular study, the 1117 parents responded to the three items as follows: *I get enough information about my child's strengths* $M = 2.44$, $SD = 0.98$; *I get enough information about my child's successes* $M = 2.72$, $SD = 0.98$; *The teacher's digital communication is encouraging for my child* $M = 2.77$, $SD = 0.95$. For the whole *Encouraging feedback* factor, $M = 2.62$ and $SD = 0.97$, indicating wide variability in responses [4].

To identify the strongest predictors of contentment with the amount of encouraging feedback, and in order to conduct the subsequent logistic regression analyses, we dichotomised the scores of the *Encouraging feedback* factor using the median (2.67) as a cut-off point. Those with a factor score of 2.67 or less were assigned to group 1 (43.7%), the others to group 2 (56.3%). We similarly dichotomised the background variables (see Table 1).

First, we carried out a decision tree analysis (DTA) to give us initial information about the chosen independent variables. DTA is used in the preliminary investigation of data for finding appropriate groups of variables and predicting future observations [41]. In this

study, according to chi square values, DTA showed the order of importance of the background variables related to contentment with the amount of encouraging digital feedback, thereby facilitating the formulation of a hierarchy of predicting variables (Figure 1).

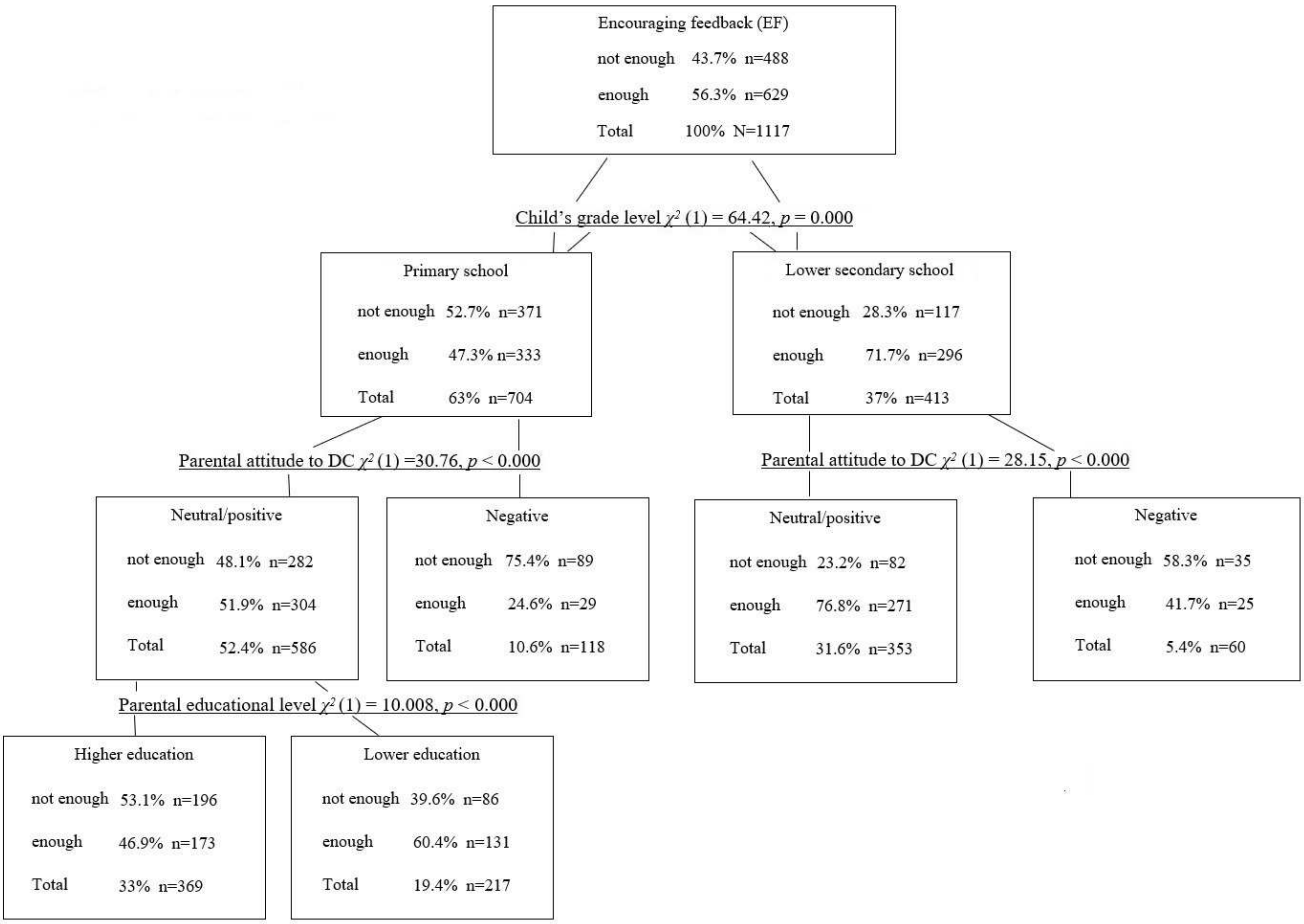

Figure 1. Decision tree showing the order of variables predicting parental contentment with the amount of encouraging digital feedback.

Following the initial DTA analysis, we carried out a binary logistic regression analysis with forward stepwise selection to establish the predictive power of each independent variable in detail. We calculated the odds of belonging to group 1 (not receiving enough encouraging digital feedback) or group 2 (receiving enough encouraging digital feedback) in the presence of the four background variables.

3. Results

The decision tree analysis (DTA) revealed the order of the predicting variables (Figure 1). The most significant predictor was the grade level of the pupil: having a child in lower-secondary school increased the probability of belonging to the group of parents who were content with the amount of encouraging digital feedback. The second most significant predictor was the overall attitude to digital communication: having a neutral-to-positive attitude was related to being content with the amount of feedback. The third predictor was parental education: being less highly educated was related to being content with the digital feedback. Parental gender was not significantly related to being content with the amount of encouraging digital feedback.

The binary logistic regression analysis confirmed the results of the DTA (Table 2). The model fitted the data well, χ^2 (3) = 136.97, p < 0.000, correctly classifying 63.9 percent of parents who were content with the amount of encouraging digital feedback and 65.6 percent of parents who were not. The overall percentage of correct classifications was

64.6. The ROC curve evidenced a tolerable goodness of fit, $W = 0.69$, $SD = 0.016$, $p < 0.001$, $CI(0.95) = 0.66–0.72$. Nagelkerke's pseudo R^2 was 0.16.

Table 2. Logistic regression analysis predicting parental contentment with the amount of encouraging digital feedback.

Measure	*B*	Wald χ^2-Test	*p*	OR	95% CI	for OR
Child's grade level	1.02	53.83	0.000	2.76	2.10	3.62
Parental attitude to DC	−1.34	53.65	0.000	0.26	0.18	0.37
Parental educational level	−0.50	14.32	0.000	0.61	0.47	0.79

Note. Parents $N = 1117$.

Next, we report the results in line with our research questions.

1. How content are the parents of pupils in primary and lower secondary school with the amount of encouraging digital feedback?

According to the initial DTA, the background variable that produced the biggest statistically significant differences between the groups as an explanatory factor for parental contentment on the amount of encouraging digital feedback was the pupil's school grade (Table 2). Parents whose children were in lower-secondary school were more content (72%) than those with children in primary school (47%). The logistic regression analysis revealed an odds ratio (OR) of 2.76 for parents of lower-secondary pupils. In other words, the parents of children on the lower-secondary level were 2.76 times more likely to be content with the amount of encouraging digital feedback than the parents of pupils at primary school (Table 2).

2. How content are parents with the amount of encouraging digital feedback depending on their attitudes to digital communication?

The DTA revealed a further split in both parental groups (with children at primary or lower-secondary school), depending on whether they had a neutral-to-positive or a negative attitude to digital communication. This variable was the second strongest predictor of contentment with the amount of encouraging digital feedback. Parents with a negative attitude were more likely to claim that they did not receive enough positive feedback (75% and 58% of those with children in primary and lower-secondary school, respectively). According to the logistic regression analysis (Table 2), parents with a negative attitude were less likely than their counterparts with a neutral-to-positive attitude to be content with the amount of encouraging digital feedback (OR 0.26).

3. How content are parents with the amount of encouraging digital feedback depending on their educational level?

The third most significant splitting variable was parental educational level. Parents on the lower levels (with a neutral-to-positive attitude to digital communication and having children in lower-secondary education) were more likely to be content (60%) with the amount of encouraging digital feedback than parents with a higher-level education (47%). Regression analysis (Table 2) confirmed that parents in the latter group were less likely to be content with the amount of encouraging digital feedback than their less-highly-educated counterparts. (OR 0.61).

4. Discussion

The aim of the present study was to investigate the factors that predict parental contentment with the amount of encouraging digital feedback in communication between homes and schools. This investigation completes a three-part series of studies on digital home–school communication in Finland. The first study identified the content that parents and teachers wanted to communicate with the help of digital tools [4], whereas the second one explored the quality of the feedback that was given and received via these tools [5].

The results of the current research reveal that of the explanatory variables we applied, the factor that best predicted parental contentment was the pupil's grade level,

with parental attitude to digital communication in second place, followed by parental educational level. Parental gender did not have a statistically significant effect.

In sum, parents with a lower educational level, a neutral-to-positive attitude to digital communication and with children at lower-secondary school are the most likely to be content with the amount of encouraging digital communication. We discuss the possible explanations for these results below in line with our research questions.

Our findings indicate that the parents of pupils in lower-secondary school are more content with the amount of encouraging digital feedback than their counterparts with children in primary school. This result is in line with those reported in a previous Finnish study about pupils´ receiving more encouraging feedback in lower-secondary school [33]. Pupils at lower-secondary school are taught by several teachers; hence, the chance of receiving encouraging feedback is higher than in the (mainly) one class teacher system in primary school. Thus, an individual teacher's feedback and communication practices do not play as big a role. Although the workload of Finnish teachers in terms of teaching hours is among the lowest in the OECD countries [42], stress and burnout rates have increased. This is a recognised trend affecting the educational field in many countries [43,44]. Having to constantly give digital feedback may, to some extent, affect how they manage their working hours, work-related stress and well-being [5,44]. This may be particularly salient among class teachers who tend to be the only feedback providers for the entire class.

It seems that teachers in the higher grade levels have mastered the skill of providing encouraging feedback by digital means, which could be interpreted as an attempt to motivate and engage students in the face of growing learning demands. Pupils in higher grades have access to personal digital feedback from the teacher. Well-given direct feedback may promote positive emotions and motivate the learning process [2,6]. Hence, the provision of encouraging feedback to pupils at lower-secondary schools may stem from a desire to target the feedback directly at the pupil. Active parental support is a prerequisite when pupils are entering a more independent phase in their studying [12]. It requires more home–school collaboration and could enhance digital home–school communication.

Overall, there are fewer face-to-face meetings and less printed communication from teachers in lower-secondary school than in primary school, meaning that almost all messaging is DC-based. Furthermore, expectations of receiving encouraging feedback may be higher among parents whose children are younger and less independent [5]. It seems that even if these parents were frequently given encouraging feedback about their children's achievements, more than half of them wanted to have more of it digitally.

Parents with an overall negative attitude to digital communication were less content with the amount of encouraging digital feedback than those with a neutral or positive attitude. This result seems obvious, but what lies behind it is more complicated. The optimal home–school partnership involves the exchange of realistic, positive information concerning the child's achievements and development [12,45]. Parents who receive multiple notes from school that are purely informative or even negative may interpret all messages accordingly. Being constantly reminded of the child's misbehaviour and learning difficulties may be burdensome and perceived as stigmatising [4,20]. Almost every class in Finland has students with special educational needs, and negative feedback easily accumulates among them [22]. Care should be taken in such cases to carry out appraisals and give extra encouragement to ensure that the home–school partnership remains respectful and positive, even in the face of obstacles [20].

Finally, our findings indicate that highly educated parents are less likely to be content with the amount of encouraging digital feedback they receive than their less highly educated counterparts. This may be attributable to the greater demands on the highly educated. They may have higher expectations, and their own experiences may influence what they consider to be a sufficient amount of encouragement form teachers. Parents who were accomplished in their own studies probably received good feedback during their school years, and probably wish the same for their own children. The positive effect

on learning outcomes and attitudes towards school among pupils with highly educated parents is well-known [39,46,47].

5. Implications

Our study findings have multiple research implications. First, the quality of encouraging feedback should be explored in detail, not only the amount. It would be beneficial to build experimental research designs to find ways of delivering personalised positive feedback time-efficiently by digital means. It would also be worth developing enriched programs for active home–school messaging using visual materials. This would be of particular value in communication with families who do not speak the same language as the teacher. Controlled interventions using innovative digital technologies could help to improve home–school collaboration among families with special needs.

We reported in our previous research [4] that parents perceived the feedback they received from teachers about their children as less encouraging than the teachers thought it was. Further research should be conducted to explore teachers' views on their feedback practices and the factors related to it. One contributory factor may be the heavy workload of teachers as well as time-management challenges. Digital platforms should be improved to offer more predefined positive options regarding digital quick-markings [33]. This concrete improvement could ease the daily workload of teachers and guide them in giving more encouraging feedback. However, teachers should not be left alone: practices related to home–school digital communication and feedback should be negotiated on the school level. Furthermore, teacher education should include courses on digital communication to ensure that future teachers acquire the necessary knowledge and competences to exploit the special nature and potential of online messaging. Parents, in turn, should be invited to reflect on their role in digital parent–teacher communication: communication is a two-way channel that should build respect in both directions.

Last but not least, digital communication could promote educational democracy. Most parents have the desire to support their child's studies actively, even if they find it difficult to attend parents' evenings and other meetings in the school. Digital communication may lower the barrier to participation and strengthen the idea of striving towards common goals in supporting pupils in their studies and their lives [4,5,12].

No study is without limitations. There was a gender bias in the current study, most of the respondents being mothers. This is in line with previous studies on the home–school partnership [18,32]: it shows that even though task sharing has become more effective in Finnish families, mothers are still the primary communicators regarding home–school issues. Furthermore, the questionnaire was provided only in Finnish, meaning that non-native speakers probably did not respond. Nevertheless, we are happy with the high number of both urban and rural participants in our three-part study [4,5]. As a methodological limitation, the use of dichotomised variables could be perceived as simplifying the data. However, the purpose of the current study was to build a general picture of the factors affecting parental views on encouraging digital feedback. Future studies will reveal more fine-grained information on how such feedback is experienced by a variety of parents, and on the kind of messages that are really understood as encouraging and as supporting pupils.

Our data was collected before the COVID-19 crisis, as a result of which digital communication was almost the only way of exchanging messages between schools and homes. The extent to which these exceptional circumstances will affect communication in the future remains to be seen. In any case, training is needed to guarantee that all teachers have good enough communication and digital skills to collaborate effectively with families of all kinds.

Author Contributions: Conceptualization, methodology, validation, A.-M.K., L.U. and K.T.; Writing—Original draft preparation, A.-M.K.; Writing—Review and editing, A.-M.K., L.U. and K.T.; Project administration, A.-M.K.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. Our study did not deal with animals or any vulnerable groups, nor did it involve risks for participant well-being, or use of biomedical devices, or invasive investigation tools. Our study did not need ethics approval, according to our national regulations as well as to the Ethical board of the University of Helsinki.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are contained within the article.

Acknowledgments: Open access funding provided by University of Helsinki.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. FNBE. National Core Curriculum for Basic Education. Helsinki: Finnish National Agency for Education. 2014. Available online: https://www.oph.fi/en/statistics-and-publications/publications/new-national-core-curriculum-basic-education-focus-school (accessed on 5 September 2020).
2. Oinas, S.; Thuneberg, H.; Vainikainen, M.-P.; Hotulainen, R. Technology-enhanced feedback profiles and their associations with learning and academic well-being indicators in basic education. *Contemp. Educ. Technol.* **2020**, *12*, ep271. [CrossRef]
3. Tanes, Z.; Arnold, K.E.; King, A.S.; Remnet, M.A. Using Signals for appropriate feedback: Perceptions and practices. *Comput. Educ.* **2011**, *57*, 2414–2422. [CrossRef]
4. Kuusimäki, A.-M.; Uusitalo-Malmivaara, L.; Tirri, K. Parents' and teachers' views on digital communication in Finland. *Educ. Res. Int.* **2019**, *2019*, 1–7. [CrossRef]
5. Kuusimäki, A.-M.; Uusitalo-Malmivaara, L.; Tirri, K. The role of digital communication in teacher well-being. *Front. Psychol.* **2019**, *10*, 2257. [CrossRef]
6. Dweck, C.S.; Master, A. Self-theories and motivation, students' beliefs about intelligence. In *Handbook of Motivation at, School*; Wentzel, K.R., Wickfield, A., Eds.; Routledge: New York, NY, USA, 2009; pp. 123–140.
7. Hattie, J.; Timperley, H. The power of feedback. *Rev. Educ. Res.* **2007**, *77*, 81. [CrossRef]
8. Wiliam, D. What is assessment for learning? *Stud. Educ. Eval.* **2011**, *37*, 3–14. [CrossRef]
9. Vuorinen, K.; Erikivi, A.; Uusitalo-Malmivaara, L. A character strength intervention in 11 inclusive Finnish classrooms to promote social participation of students with special educational needs. *J. Res. Special Educ. Needs* **2019**, *19*. [CrossRef]
10. Griffin, N.L. Using assessment feedback for motivation among early adolescents: A grounded theory study. Ph.D. Thesis, Liberty University, Lynchburg, VA, USA, June 2018.
11. Epstein, J. School, family and community partnership. *Phi Delta Kappan* **1995**, *76*, 702–712.
12. Epstein, J.L.; Sanders, M.G.; Sheldon, S.; Simon, B.; Salinas, K.C.; Jansorn, N.R.; van Voorhis, F.L.; Martin, C.S.; Thomas, B.G.; Greenfeld, M.D.; et al. *School, Family, and Community Partnerships: Your Handbook for Action*, 3rd ed.; Corwin Press: Thousand Oaks, CA, USA, 2009.
13. Kumpulainen, K.; Lipponen, L.; Hilppö, J.; Mikkola, A. Building on the positive in children's lives: A co-partipatory study on the social construction of children's sense of agency. *Early Child Dev. Care* **2013**, *184*, 211–229. [CrossRef]
14. Perälä-Littunen, S.; Böök, M.-L. Finnish teacher-students' views on home-school cooperation. *Int. J. Parents Educ.* **2019**, *11*, 37–45.
15. OECD. *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*; OECD Publishing: Paris, France, 2019. [CrossRef]
16. OECD. Pisa Results, Programme for International Student Assessment. 2018. Available online: https://www.oecd.org/pisa/publications/pisa-2018-results.htm (accessed on 25 August 2020).
17. Mendel, M. Education is power and parents are force. *Int. J. Parents Educ.* **2020**, *12*, 1–7.
18. Bauch, J.P. Applications of technology to linking schools, families, and students. In Proceedings of the Families, Technology, and Education Conference, Chicago, IL, USA, 30 October–1 November 1997; Available online: https://eric.ed.gov/?id=ED425017 (accessed on 22 December 2020).
19. Freytag, C.E. Teacher-parent communication: Starting the year off right. Paper presented at the Biennial Meeting of the Kappa Delta Pi International Honor Society in Education. November 2001. Available online: https://eric.ed.gov/?id=ED460087 (accessed on 31 August 2020).
20. Dannesboe, K.I.; Kryger, N.; Palludan, C. When school-family relations matter-discomfort and struggle among children, young people and their parents. *Int. J. Parents Educ.* **2019**, *11*, 55–65.
21. Oinas, S.; Ahtiainen, R.; Vainikainen, M.-P.; Hotulainen, R. Pupils' perceptions about technology-enhanced feedback: Do emojis guide self-regulated learning? *Scand. J. Educ. Res.* 2020. [CrossRef]
22. Oinas, S.; Vainikainen, M.-P.; Hotulainen, R. Is technology-enhanced feedback encouraging for all in Finnish basic education? A person-centered approach. *Learn. Instr.* **2018**, *58*, 12–21. [CrossRef]

23. Alanko, A. Preparing pre-service teachers for home-school cooperation: Exploring Finnish teachers education programmes. *J. Educ. Teach.* **2018**, *44*, 321–332. [CrossRef]
24. Levinthal, C.I.; Kuusisto, E. Parental engagement in children's learning: A holistic approach to teacher-parents' partnerships. In *Pedagogy in Basic and Higher Education*; Tirri, K., Toom, A., Eds.; IntechOpen: London, UK, 2020. [CrossRef]
25. Finnish National Agency for Education (FNAE). Compulsory education in Finland. 2018. Available online: https://www.oph.fi/sites/default/files/documents/compulsory_education_in_finland.pdf (accessed on 4 September 2020).
26. Tirri, K. The last 40 years in Finnish teacher education. *J. Educ. Teach.* **2014**, *40*, 600–609. [CrossRef]
27. Ministry of Education and Culture. Extencion of Compulsory education in Finland. 2020. Available online: https://minedu.fi/en/-/compulsory-education-to-be-extended-in-august-2021-reform-aims-to-improve-conditions-for-learning-and-wellbeing-among-young-people-and-to-increase-employment-rate (accessed on 31 August 2020).
28. Sormunen, M.; Goranskaya, S.; Kirilina, V.; Tossavainen, K. Interaction between home and school: The views of teachers and parents from Finland and Russia. *Int. J. Parents Educ.* **2018**, *10*, 33–46.
29. Ojakangas, M. *Lapsuus ja Auktoriteetti. Pedagogisen Vallan Historia Snellmannista Koskenniemeen*; Childhood and AuthorityTutkijaliitto Hansaprint: Helsinki, Finland, 1997.
30. Carr, N.; Heath, D.; Maghrabi, R. Implications of information and communication technologies (ICT) for school-home communication. *J. Inf. Technol. Educ. Res.* **2015**, *14*, 363–396. [CrossRef]
31. Chu, S.-Y. erspectives from both sides of the parent–professional partnership: A preliminary study on taiwan's early childhood special education services. *PInt. J. Disabil. Dev. Educ.* **2018**, *65*, 355–372. [CrossRef]
32. Palts, K.; Kalmus, V. Digital channels in teacher-parent communication: The case of Estonia. *Est. Int. J. Educ. Dev. Inf. Commun. Technol.* **2015**, *11*, 65–81.
33. Oinas, S.; Vainikainen, M.-P.; Hotulainen, R. Technology-enhanced feedback for pupils and parents in Finnish basic education. *Comput. Educ.* **2017**, *108*, 59–70. [CrossRef]
34. Hu, C.; Wong, A.F.L.; Cheah, H.M.; Wong, P. Patterns of email use by teachers and implications: A Singapore experience. *Comput. Educ.* **2009**, *53*, 623–631. [CrossRef]
35. Seitsinger, A.M.; Felner, R.D.; Brand, S.; Burns, A. A large-scale examination of the nature and efficacy of teachers' practices to engage parents: Assessment, parental contact, and student-level impact. *J. School Psychol.* **2008**, *46*, 477–505. [CrossRef] [PubMed]
36. Hofstede, G.; Hofstede, G.J.; Minkov, M. *Cultures and Organizations: Software of the Mind*, 3rd ed.; McGraw-Hill: New York, NY, USA, 2010.
37. Chzhen, Y.; Gromada, A.; Rees, G. Are the World's Richest Countries Family Friendly? Policy in the OECD and EU. 2020. Available online: https://www.unicef.org/media/55696/file/Family-friendly%20policies%20research%202019.pdf (accessed on 18 September 2020).
38. European Parliament. Maternity and Paternity Leave in the EU. Infographic—December. International Network On Leave Policies and Research, International Review of Leave Policies and Related Research. 2016. Available online: https://www.leavenetwork.org/fileadmin/user_upload/k_leavenetwork/annual_reviews/2016_Full_draft_20_July.pdf (accessed on 11 September 2020).
39. Statistics Finland. Educational Structure of Finnish Population. 2019. Available online: https://www.stat.fi/til/vkour/2019/vkour_2019_2020-11-05_tie_001_en.html (accessed on 18 September 2020).
40. Finnish Advisory Board on Research Integrity. Ethical Principles of Research in the Humanities and Social and Behavioural Sciences and Proposals for Ethical Review. 2009. Available online: https://www.tenk.fi/en/ethical-review-in-human-sciences (accessed on 20 July 2020).
41. Metsämuuronen, J. *Essentials of Research Methods in Human Sciences. Volume 2, Multivariate Analysi*; Sage Publications India Pvt Ltd.: New Delhi, India, 2017.
42. OECD. Published Data: Teachers Teaching Hours. 2019. Available online: https://data.oecd.org/teachers/teaching-hours.htm (accessed on 5 May 2021).
43. Chang, M.-L. An appraisal perspective of teacher burnout: Examining the emotional work of teachers. *Educ. Psychol. Rev.* **2009**, *21*, 193–218. [CrossRef]
44. Skaalvik, E.M.; Skaalvik, S. Teacher job satisfaction and motivation to leave the teaching profession: Relations with school context, feeling of belonging, and emotional exhaustion. *Teach. Teacher Educ.* **2011**, *27*, 1029–1038. [CrossRef]
45. Juniu, S. Computer mediated parent-teacher communication. *Rev. Electrónica Actual. Investig. Educ.* **2009**, *9*, 1–19.
46. OECD. *Education at a Glance: OECD Indicators*; OECD: Paris, France, 2015.
47. Hautamäki, A. activity environment, social class and educational career: Development of mastery among 11–17-Year-Olds. *Scand. J. Educ. Res.* **1986**, *30*, 1–16. [CrossRef]

education sciences

MDPI

Article

Nature of Science (NOS) Being Acquainted with Science of Science (SoS): Providing a Panoramic Picture of Sciences to Embody NOS for Pre-Service Teachers

Ismo T. Koponen

Department of Physics, University of Helsinki, 00014 Helsinki, Finland; ismo.koponen@helsinki.fi; Tel.: +358-2941-50652

Abstract: Understanding about nature of science is important topic in science education as well as in pre-service science teacher education. In science education, Nature of Science (NOS), in its different forms of educational scaffoldings, seeks to provide with students an understanding of features of scientific knowledge and science in general, how scientific knowledge changes and becomes accepted, and what factors guide scientific activities. For a science teacher, deep and broad enough picture of sciences is therefore of importance. This study attempts to show that the research field called Science of Science (SoS) can significantly support building such a panoramic picture of sciences, and through that, significantly support NOS. The SoS approaches the structure and dynamics of science quantitatively, using scientific documents (e.g., publications, reports, books and monographs and patent applications) as trails to map the landscape of sciences. It is argued here that SoS may provide material and interesting cases for NOS, and in so doing enrich NOS in a similarly significant way as history, philosophy and sociology of science (HPSS) scholarship has done thus far. This study introduces several themes based on SoS that are of relevance for NOS as they were introduced and discussed in a pre-service science teachers' course. The feedback from pre-service teachers shows that introducing SoS, with minimal additional philosophical interpretations and discussions, but simply as evidential facts and findings, sparks ideas and views that come very close to NOS themes and topics. Discussions related to nature of science, and specific educational NOS scaffoldings for it, can find a good companion in SoS; the latter providing facts and evidence of thee structure and dynamics of sciences, the former providing perspectives for interpretations.

Keywords: nature of science; science of science; science; scientific knowledge; scientometrics

Citation: Koponen, I.T. Nature of Science (NOS) Being Acquainted with Science of Science (SoS): Providing a Panoramic Picture of Sciences to Embody NOS for Pre-Service Teachers. *Educ. Sci.* **2021**, *11*, 107. https://doi.org/10.3390/educsci11030107

Academic Editor: Kirsi Tirri

Received: 6 February 2021
Accepted: 2 March 2021
Published: 5 March 2021

1. Introduction

Nature of Science (NOS) is today an integral part of science education as well as a recommended part of science teacher education [1–4]. Its purpose is to provide students with a picture of science and scientific knowledge that is simple enough to be useful and viable for purposes of school education, but that would still convey a sufficiently authentic view of science and present it as a part of larger societal endeavours [2,3,5–8]. The importance of NOS as part of a school curriculum, as well as its themes, are broadly agreed, which has resulted in shared core, which is referred to as a consensus view of NOS [1]. However, if there is a consensus of basic themes, the debate on how NOS should approach and reach its goals are continuing [9–15]. Many surveys have also shown that scientists have views and opinions about science that are not in concordance with the views contained in NOS [10,11,16–19]. Debates surrounding NOS and its assumed faultlines have been discussed and summarised in several reviews see, e.g., [3,9,13,19–26]), and some alternatives to the original versions of NOS have been suggested [22,23,27]. Here, such discussions are not repeated, nor alternative versions of NOS are suggested to correct or straighten the supposed fault lines. However, to put the present study in a perspective

of wider discussion about NOS, a summary is made of some of the fault lines that have tangential contact with topics discussed here.

The consensus view of NOS has been criticised for being too vague and insensitive to important disciplinary differences, and in addition, providing a false picture of science, of the nature of its knowledge as well as of the practices of science (see, e.g., [9,11–16,19,21,25,26,28]). Some authors have claimed that NOS is essentialist in the sense that it seeks the essential nature of science, and dogmatic in that it seeks integrated and consolidated views [20]. In large part, such discussions of NOS repeat many themes familiar from early criticism that NOS does not correspond to the views of science philosophers (see, e.g., [29–31]), or those of practicing scientists [17,18]. The former criticism was addressed by Schwartz et al. [32,33], and the latter by Abd-El-Khalick [1]. In both cases, it was noted that consensus NOS is quite open to different positions and allows great flexibility regarding how ideas and views at different levels of sophistication can be accommodated within its general schemes. According to Abd-El-Khalick [1], the assumed essentialism or dogmatism are largely consequences of reading too much into simplifications that are meant to make NOS appropriate for school-level instruction, but are easily relaxed at higher levels of education where more in-depth discussions are appropriate [1]. Abd-el-Khalick [1], in providing arguments supporting consensus NOS and its broadness of views, points out that consensus NOS distances it from too detailed epistemological and philosophical commitments, and that this distancing can be seen rather an advantage than a shortcoming.

In regard requirements that NOS should better take into account the views of practicing scientists, one encounters the problem that these views are very context-dependent and have very little coherence with regard to epistemology (see, e.g., [16]). As such, they provide awkward grounding for developing practical solutions for teaching, although they would otherwise provide insights on how and why scientist differ in their views about epistemological questions.

The basic goals that NOS seeks to fulfill are broad and general: to provide an understanding of features of scientific knowledge and science in general, how scientific knowledge changes and becomes accepted, and what kinds of factors guide scientific activities. Such goals are of particular importance to pre-service science teacher education. In practice, however, it is not uncommon to find that the differing views of scientists and science teacher educators create certain tensions similar to those documented in research focusing on scientists' views about NOS themes. However, it is not necessary to change NOS so that it could accommodate the different views of practicing scientists, or on the other hand, better correspond to certain preferred philosophical stances like some version of realism. On the contrary, we can see the strength of NOS in its ambivalence to such positions, which allows its use as a basic scheme to see science through different lenses and provide a scaffolding to recognise what kinds of lenses one uses.

The practical purpose of this study is to discuss how a recent research field called Science of Science [34] can contribute to NOS. It is argued that many findings and notions of Science of Science are relevant to NOS, and that SoS can provide material for NOS to discuss different aspects and features of science from perspectives a chosen NOS viewpoint offers. The viewpoint adopted on NOS in this study comes close to consensus NOS in acknowledging the necessity of flexibility and broadness taking distance from specific philosophical epistemological positions. The categorization of themes as contained in consensus NOS is found here appropriate for discussing the topic of the present study. For practical purposes of organizing the presentation, this study adopts a similar kind of thematic categorization as in consensus NOS. This, however, does not mean endorsing or preferring any more specific details of consensus NOS, to which the present study remains indifferent. Instead, this study adopts a certain ambivalence to specific epistemological stances and does not take stance on how Science of Science might support one or another version of NOS, or how it can be used to evaluate merits of different versions of NOS.

Science of Science (SoS) is a quantitative, data-driven research field that explores science through scientometrics (e.g., citation analysis), linguistic concept analyses, social network analysis and using big-data analysis, network methods and data-mining to analyse documents like research publications, reports and similar written or digitally-available documents (see, e.g., [35–41]). Such research shares the interest of history, philosophy and sociology of science (HPSS) in studying science, its structure and dynamics, and the factors that drive those dynamics. In that, SoS is complementary to HPSS in that it is quantitative, data-driven and focuses on large-scale phenomena of contemporary science, rather than being interpretative, history-oriented and making use of case studies. The SoS may significantly embody notions contained in NOS, and thus enrich NOS equally significantly as HPSS scholarship has done thus far. To clarify, the purpose of the present study is not to suggest augmenting NOS themes but to show that the existing scheme can be adapted perfectly well to accommodate themes arising from SoS; the findings and results emerging from SoS are material to enrich discussions through the lenses provided by NOS.

Here, I first briefly discuss the aspects of consensus NOS that are relevant to the present study and also outline in more detail the faultlines seen by its critics. Second, I outline Science of Science (SoS) as a research field. It is also informative to discuss why we may believe that the disciplinary structure of science and dynamics of science can be approached by paying attention to language, and how scientific communities use language and share terms and concepts within and between the communities. Third, in the most extensive section of this study, I summarise several findings of SoS that make contact with NOS themes. Finally, I briefly discuss implications of SoS for science teacher education and share some experiences from a recent university level course where SoS topics were discussed. With this study, I wish to convince educators interested of NOS to familiarise themselves with the findings and results of SoS, which might be a great source of examples relevant to NOS.

2. Consensus NOS: Some Supposed Fault Lines

In science education the most widely adopted viewpoint is consensus NOS that is based on views by Lederman, McClough, Abd-el-Khalick and their collaborators [4,6,8]. The consensus view on NOS is consolidated by seven tenets (see, e.g., refs. [5–7] and references therein): (1) the empirical nature of science, (2) the character of scientific theories and laws, (3) the creative and imaginative nature of scientific knowledge, (4) The theory-ladenness of scientific knowledge, (5) the social and cultural embeddedness of scientific knowledge, (6) the myth of (a single) scientific method, and, (7) the tentative nature of scientific knowledge. Here, theory-ladenness refers to how meaning and use of concepts are theory related and how that affects recognising and framing phenomena. The social and cultural embeddedness, on the other hand, refer to how science affects and is affected broader cultural factors and heritage, social fabric of society and its institutions as well as power structures and political and economic factors [1]. The initial NOS movement sought to dispel certain common views of science that it took as misguided and unfounded, for example: the immutability of scientific knowledge, and the existence of a single scientific method and its infallibility. To understand the nature of NOS and the debates around it, it is essential to understand that NOS is a science educators' view of science, distilled from views on science as scholars in the history, philosophy and sociology of science (HPSS) and science and technology studies (STS) have seen it. On that basis, consensus NOS is designed to support the formation of conceptions of science that serve the purposes of general education. Therefore, judgements about the acceptability of consensus NOS should not be grounded on how it compares to positions in philosophy of science (PoS) or to the views of practicing scientists, but instead how it manages to achieve its primary goals. Nevertheless, it is of interest to examine where the critics of consensus NOS have seen fault lines.

Already from at its beginning, the underpinnings of NOS were questioned [29] and debated [30,31,42]. Similar debates have emerged and faded repeatedly over the years (see, e.g., [9,13,21,25,26]). Critics of consensus NOS have often argued that it is too broad and based on overly vague notions, that it ignores important aspect of science and scientific knowledge (e.g., [11,13,28,43]), or even that it provides a distorted picture of scientific knowledge and the aims of science [9,15]. The critics of NOS often seek support from different versions of realism [9,13,15,21] and sometimes from more specific views borrowed from philosophy [19,22,23,25,26]. The critics have advocated views to augment or even to replace the consensus views of NOS by better founded or justified views, where support is sought from science philosophy, in some cases blending several varieties of realistic positions and semantic views on theory [9,13,21,25,26] or from very specific version of philosophical positions like critical realism [19] (see also [15,20,24]). As already pointed out in the early debates, such criticism ignores the purpose of general basic notions contained in NOS about which there is broad agreement within contemporary philosophy of science. The criticism pays too much attention to finer epistemological details of differing views and the professional discussions related to them (see, e.g., [31,42]). Moreover, the focus on such finer philosophical details has rarely produced practical teaching solutions. An exception is an alternative view to consensus NOS, known as the Family Resemblance Approach (FRA), suggested by Erduran and Dagher [22,23,27], based on the views of Irzik and Nola [25,26]. The FRA takes into account the disciplinary variation within sciences but recognizes that different scientific disciplines always have some sets of shared features; there is a family resemblance between and among disciplines. However, in closer look, focusing on how FRA becomes implemented in practical teaching, the outcome appears to be close to consensus NOS (see also [1]).

The criticism raised against consensus NOS and its imagined failures is nearly always raised on philosophical grounds, pointing out deficiencies when compared to adopted philosophical epistemological underpinnings, often some version of realism. Interestingly, the productivity of traditional epistemological issues (for example, truthlikeness and objectivity of knowledge, and questions related to realism versus constructivism) in understanding science has been challenged by the so-called philosophy of science practice (PSP), which turns away from metaphysically-oriented epistemological questions (see, e.g., [44,45]). While the reasons of PSP for its turning away from traditional epistemological and metaphysical positions may not be relevant for NOS, it reminds us that PoS does not offer unambiguous or self-justified positions to be taken as basis of NOS, but rather, different and varied lenses to view the sciences, each of them focusing differently but each also producing different distortions.

To escape from the ambiguity of philosophical positions, some critics have supported their arguments about the deficiencies of NOS with the results of case studies of practising scientists' views [10,11,16–19]. While this approach appears reasonable and productive at first, it has a recognisable weakness; scientists' views are so varied that nearly all positions discussed in philosophy of science can be found, but very little coherence (see, e.g., [19] for a review). Scientists' views provide a mixture of stances in which epistemic and ontological aspects are mixed, they are very context-dependent and weighted differently in regard to the practice of science (doing of science and scientific activities) and outcomes of science (body of scientific knowledge). Consequently, scientists' views reveal a mixture of realistic, constructivist, instrumental, pragmatic and anti-realistic views (see, e.g., [16,19]). This conclusion finds support from a recent extensive study of the views of practicing scientists regarding realism and its alternatives [46]. The study involved nearly 1800 scientist from seven fields of sciences, including physics, chemistry and biology as quantitative natural sciences, sociology and anthropology as qualitative sciences, and psychology and economy between these poles. In addition, five scholars from the field of history, philosophy and science (HPS) were interviewed and their views were compared with scientists' views. It was found, according to expectations, that there is indeed a clear difference in views between scientists and HPSS scholars; scientists favour realism more often than HPSS

scholars, who tend mostly to reject realistic positions. The situation, however, is not entirely that simple. Scientists also widely accepted the constructive empiricist position and the notion of empirical adequacy contained in it [46], and even clear anti-realistic stances if they were restricted to pragmatic aspects and practices of science instead of scientific knowledge as a product of science [46]. This again confirms the finding that scientists hold views that (from the point of view of more orthodox philosophies) contradict and even exclude each other. These notions provide enough basis to be cautious with regard to all arguments in which scientists' opinions are taken as guidance to form a picture of science; such a picture is certainly a canvas of scientist opinions but not necessarily useful to guide NOS at school level nor a as starting point for science teacher education. Rather than guidance to develop positions to understand science, scientists' views should be material to reflect on how positions based on PoS, HPSS and STS might help us to understand such positions and how they might or might not affect science and scientific knowledge.

Some authors have criticised NOS for assuming that science has an "essence" or "nature", and that such an essence can be consolidated in a form of scaffolding for the purposes of teaching [20,47]. A recent study that compared consensus NOS and one of its alternatives, Family Resemblance Approach (FRA) on NOS [22,23,27] raised similar critiques against them both [20]. It claimed that both consensus NOS and FRA are essentialist approaches on the nature of science in assuming that an essence characterising all science can be found, and dogmatic in the sense that they provide a single integrated framework to recognise that essence [20]. As a remedy, the authors suggested taking the viewpoint of Wittgensteinian language games to open up different windows on how the nature of science could be understood and discussed, and to give up the attempt to provide consolidated, integrated views in the form of lists or tenets. At a closer look, as visible in a response by Abd-El-Khalick [1] to similar critical remarks about dogmatism and normativity, such notions arise from assuming too much about (or reading too much into) the basic tenets of NOS. The very purpose of NOS is to provide practical approaches and designs for school-level teaching, where appropriate simplifications are needed. However, the level of sophistication can be raised when NOS is discussed at the level of science teacher education, when more in-depth discussions of the viewpoints offered by different positions become possible [1].

The critical evaluation of the underpinnings of NOS and FRA by do Nascimento Rocha and Gurgel [20] suggests that some of the faultlines seen by critics of consensus NOS are not necessarily very serious ones. First, NOS might benefit if it takes distance from the views offered by traditional philosophical accounts and their well-organised and neatly-arranged pictures of sciences. Instead, NOS should face and accept the complexity, unorganised nature, and plurality of science. Such a view opens up an approach that is more objective and less tied to a fixed and normative conception of how we should view science. Such a step also seems well aligned with consensus NOS, which emphasises the socio-scientific factors and social embeddedness of science, and how scientific knowledge is affected by these factors. As will be suggested later, a step in that direction could be taken using examples provided by Science of Science (SoS) but retaining the core ideas of consensus NOS to provide a scaffolding to discuss the findings of SoS. For a science teacher, SoS based on empirical evidence and concrete examples may help to embody the broad and general notions contained in consensus NOS. Second, NOS ought to turn away from traditional philosophy and its metaphysically-oriented discussion about the truth-value of knowledge or truth-likeness and endless debates on the preferability of some versions of realism over some version of constructivism. It is important to realise and understand that such different views exist and how science appears differently through such different lenses, because every one of them focuses differently. It is not, however, important or productive to select between the views or exclude some of them in favour of another; they can all serve to provide an understanding of science, and scientific knowledge and practices. Somewhat unexpectedly, giving up the many traditional questions related to the

epistemology of science and focusing on practices aligns better with the view provided by SoS than views based on traditional philosophical underpinnings.

3. Science of Science: An Acquaintance Deserving to Be Better Known

Many of the topics of interest for NOS, in particular the social and institutional factors of science, scientific inquiry and dissemination of scientific results, are explored by the research field called Science of Science [34]. The idea of Science of Science as a quantitative approach in exploring science itself goes back to seminal works by Garfield [48] and De Solla Price [34] and is today an intense data-driven field of study, drawing on the possibilities of data-mining and big-data analysis [35,37–41,49].

The Science of Science (SoS) is a quantitative study of sciences. The sources of data and information for SoS are scientific documents: academic publications, monographs and textbooks, as well as other written reports like research and patent applications. SoS mines connections between such documents based on citation analysis, textual analysis, and content analysis, for example of how vocabularies, terms and basic concepts are shared and adopted, and how they diffuse from one document to another. Structural connections based on such analyses are then taken as evidence of disciplinary connection, for example shared use of terms and concepts as cohesion of certain disciplines, unshared use of concepts as a sign of different disciplines [37–41,49]. Similarly, in citation analysis, recurrent collaboration patterns are taken as signs of collaboration and shared research interests, publications in shared forums as signs of institutional cohesion of the community. SoS touches on many important social and institutional factors that affect the formation of scientific communities [37,39,50].

Over the last two decades, the developments of big-data analysis and data-mining have opened up unforeseen opportunities to expand the scale of SoS and to deal with millions of documents. Methods to explore the vast data sources are rapidly increasing and becoming ever more sophisticated, producing a valuable source of evidence-based results about the structure of science. In exploring the documents, SoS makes use of data-mining algorithms, network based methods of analysing the relevant connections, and relationships in the data [37,39,50]. One important output of SoS has been different maps of the disciplinary structure of sciences, which provide a panoramic view on the universe of different sciences. Such maps are invaluable for providing an overall picture of the landscape of science and how different fields are related, and they show very clearly the nested disciplinary structure. The maps also reveal internal dynamics of the sciences by showing how disciplinary boundaries have changed, appeared and disappeared, and how new disciplines have emerged (see, e.g., [36–39]).

As a quantitative, data-driven research field, SoS is largely independent of the philosophical underpinnings one often finds in HPSS, where interpretative viewpoints are often motivated through considerations based on philosophy of science. Nevertheless, it is of interest to note that the approach of SoS, in paying attention to linguistic and semantic structures to understand science, its structure, and the communities within it, aligns well with Thomas Kuhn's conception of science, which he developed after their well-known work "The Structure of Scientific Revolutions" [51]. In their later research [52], the focal point of their views shifted to linguistic structure [53,54]. On the basis of importance of linguistic structures, Kuhn introduced lexicons (of scientific language), which became central to their views of scientific communities and thus, of the disciplinary structure of science that they constituted. The systematic and correct use of lexicons characterises scientific communities, not its individual subjects. The correct, systematic and normative use of lexicons, on the other hand, is revealed by how the community approaches its basic problems and uses the lexicons in problem solving, and how it instructs its members and newcomers using lexicons. [52–54]. Kuhn's view of the importance of language and lexicons in shaping science, its communities, and even its worldviews, owes much to Wittgenstein's language games (see [53,54]). Such views, aligned with SoS, would be an

interesting direction in which to further push the ideas of how NOS could make better use of Wittgensteinian language games, as suggested by some researchers [20,47].

SoS, however, does not derive its motivation and underpinnings directly from any specific philosophical views like Kuhn's or Wittgenstein's (which are only seldom mentioned in the context of SoS) although we may recognize paralleling views in how SoS too pays attention on how science is communicated and how the use of language of science provides identity and cohesion for scientific communities, and how language and its use is present in discussing, framing and solving problems and deciding what is relevant and worth effort, resulting eventually in the production of scientific knowledge. Such focal points of course will miss many of the interesting and insightful discussions HPSS can provide by using underpinnings grounded in philosophy of science, sociology of science and science and technology studies. Nevertheless, despite the limitations that come with such an approach, SoS provides a treasure trove to enrich and enflesh NOS. It may provide significant support for NOS in opening up views of science that are complementary to HPSS and focus more strongly than HPSS on a panoramic picture of contemporary science. Therefore, SoS is a field that deserves to better known and appreciated as part of NOS.

4. Science of Science Themes for Embodying Nature of Science

Contemporary Science of Science (SoS) provides many access points to NOS-related discussion and the kind of raw material and evidence that needs to be embedded within NOS themes and viewpoints. On the other hand, in this way SoS helps to embody the general and idealised notions contained in NOS. For example, discussing the need for disciplinary-specific approaches to NOS (at the level of higher education and teacher education) becomes more fruitful when one has basic information on the features of that structure, its dynamics, and the factors affecting the dynamics. In addition, questions about the theory-ladenness (meaning theory relatedness of concepts and how phenomena are framed) and role of theories and experiments can be made more concrete through examples of how the relationship between theoretical and empirical research appears in the light of SoS. Many similar valuable ways are now available from the vast and rapidly-expanding literature of SoS. In what follows, some themes and possible sources are discussed. Later, a short summary is provided on how the themes discussed might fit in with NOS themes.

4.1. Disciplinary Structure of Sciences

The disciplinary structure of scientific knowledge is an extensively researched topic in Science of Science, and the results with regard to the disciplinary structure show not only the clear structure of disciplines, but also a certain stratification within it, as well as cultural and societal country-related differences in disciplinary profiles. Therefore, the key question is not about the existence of that structure, but about its form, how one can get information about it, and whether different sources of information provide a different picture. In Science of Science literature, the disciplinary structure is discussed in many studies and from many different viewpoints, for example: techniques for mapping structure [41,55,56]; disciplinary layout [57–59]; structural similarity [60,61]; and interdisciplinarity [62,63].

The macrolevel analysis of the structure of sciences reveals a clear disciplinary structure, which is a starting point for understanding the nature of science and the dynamics that shape the disciplinary structure. The analyses of disciplinary structure are most often based on citation and scientometric analyses, and include sciences from medicine to mathematics [36,39,40]. Similar studies with very similar results are also obtained by focusing on shared concepts and terms [64]. In such analyses, different areas of science, from biological sciences and medicine to physics and mathematics, fall into clusters with clear borders; that is, disciplinary clusters. The details of the structures and substructures may differ depending on the method of analysis and its sources, but all studies lead to rather similar outcomes regarding the disciplinary areas: medicine, biomedicine, biology in one cluster; physics, astronomy and earth sciences in another; electrical engineering and engineering in their cluster and so on, with tighter connections between closely-related areas.

In a study by De Domenico et al. [36], covering one hundred years of sciences, researchers' activity in publishing in certain disciplinary fields is investigated in detail. The results of the study show how different disciplines were rather closed a century ago, not interacting so much with other disciplines and with researchers contributing mainly within their own areas. Border crossings started to become more prominent only 50 years ago, first with a clear flow of knowledge between the areas of medicine, biochemistry, genetics and molecular biology, and on the other hand, between disciplines in a cluster of physics and astronomy and earth and planetary science, as well as between the disciplinary clusters of chemistry and chemical engineering. Interestingly, however, some areas like nursing and health professions already had open boundaries a century ago [36]. Today, the flow of knowledge across borders is common between practically all areas. Most disciplinary areas have had an initial stage of development where they stay rather isolated, but eventually they develop more open boundaries with other disciplines, with strong flows of knowledge across the boundaries [36]. The disciplines of medicine, physics, astronomy, chemistry and mathematics, however, have stayed more isolated than some other fields. On the other hand, some disciplines like computer science and environmental science have developed over the last decades from isolated disciplines to ones with remarkably open boundaries and significant flows of knowledge to other disciplines. This very central role of computer sciences is obviously related to recent public investments in multidisciplinary research on artificial intelligence, which has boosted the flows of knowledge between computer science, mathematics, cognitive science, philosophy of mind and electrical engineering [36]. Such examples show that while the disciplinary structure can be resolved quite clearly, there is increased flow of knowledge between the boundaries without the tendency for boundaries to dissolve or become invisible.

The case of medicine and physics is interesting on closer inspection. Although these disciplines appear as isolated when the mobility of authors between the disciplinary areas is inspected, their contribution to overall flow of knowledge is remarkable when flow of knowledge and use of knowledge is in focus. This viewpoint shows that, while researchers in these areas stay within them, the results are widely used in different contexts, but knowledge also flows from other areas of those disciplines; medicine and physics act as sources and sinks of knowledge in the bigger picture [36]. This is apparently related to the wide applicability of techniques and methodologies developed within these fields. A similar notion comes up on the basis of investigating the co-occurrence of shared concepts in books and monographs. Such results too show the importance of medicine and physics as well as chemistry and mathematics to all branches of natural sciences, demonstrating the importance of those sciences for many other disciplines [65].

4.2. Subdisciplinary Structure: Physics and Chemistry

A gradated subdisciplinary structure is found also within disciplines. Within disciplines, the isolation and importance of subdisciplines may also vary significantly. Such a situation is exemplified by detailed studies of disciplinary substructures in physics [66–69]. Physics as a discipline is an interesting case because of its role, as seen in the previous section, in connecting and underlining many other disciplines. As noted for example by Sinatra et al. [67], one reason for this role is that physics has always been in dialogue with many other disciplines, especially mathematics and chemistry, and that the dialogue has been driven by methodologies that transgress the boundaries.

An extensive study by Sinatra et al. [67], based on about 5 million published papers in physics between 1900 and 2012, show that it is possible to distinguish a core of physics papers (2.4 million) and interdisciplinary non-physics papers (3.2 million) that refer to that core and are of interest for physics. Interestingly, within the non-physics papers, six physics Nobel-prize winners can be identified. This demonstrates strikingly the important role of physics in other sciences. A closer examination of the papers in the physics core shows the important role of quantum physics in emergence of many new fields, from condensed matter physics to nuclear physics. Since then, the growth of papers published in physics

has been nearly exponential. The growth was especially rapid after the Second World War, and settled down in the 70s to the current rate, at which the number doubles in about 19 years [67]. However, as pointed out in another study [70], the exponential growth of literature does not mean that new ideas and conceptualizations increase similarly; rather, the increase in cognitive content (as measured by terms indicating new concepts and conceptualizations) has since 1930s increased only linearly and actually slowed down after the 70s. As Sinatra et al. points out, the growth rate of publications in physics is an outcome of societal needs, access to resources, and simply an increase in the number of researchers.

Physics was up to the late 1930s mostly an isolated field of study and also quite shortsighted in noting literature even in its own field, with references extending only some years to previously published results [67]. A change started to take over in the late 1930s, with a rapid increase in publishing physics-related results outside the physics core literature, indicating the importance of other fields to physics and, in reverse, the importance of physics to other fields. This change was partly, but not entirely, related to the rising importance of the new quantum physics. However, in the 1960s a period of stronger isolation of physics and in subdisciplines within physics set in, but soon after that, gave way to deeper and broader attention to fields outside but also within physics. The explanation suggested by Sinatra et al. for this change is a change in reviewing practices, which changed in broader scale from editorial acceptance to peer-review, and subsequently through peer-review, forced researchers to note results in related fields more broadly. Interestingly, according to Milojevic [70], in physics the late 1960s and subsequent 1970s was a period of lower publication rate growth, but a rise in the number of new ideas and concepts. Such dynamics and changes in dynamics where changes might be triggered by academic practices and changes in norms, and where growth in the number of scientific results does not correlate with an increase in conceptual extent, are important examples of the complex dynamics of sciences. It also warns against adopting simple pictures of a cumulative, ever-increasing body of knowledge, which grows only by its internal logic and dynamics.

Bibliometric analyses reveal that the disciplinary substructure of physics consists of three large communities or clusters: the first cluster consists of condensed matter physics and interdisciplinary physics and related fields; the second cluster involves electromagnetism, atomic and plasma physics; the third cluster contains particle, nuclear and astrophysics [67]. Within a given cluster, the fields cite subfields within them frequently, but not so often subfields that belong to other clusters. Between the subdisciplines, it is possible to even find citation barriers, showing a strong tendency to a certain isolation of the subdisciplines. Among the subdisciplines, particle and nuclear physics appear to be the most isolated subfields. General physics, however, has a special role since it unites all these three fields. The emergence of such disciplinary clusters is much as expected, but it is interesting that citation analysis reveals the existence of clusters so clearly, as demonstrated in the study by Sinatra et al. [67]. Similar results are also obtained in other similarly focused studies, where roughly the same subfields are recognised [66,69].

The connectedness and isolation of different physics subfields are interestingly related to the lifetime of scientific publications in different fields [67]. The lifetime of publications is at least partially related to the timescales of change and evolution of scientific knowledge within the disciplines. Old knowledge is not necessarily abandoned or entirely changed, but incorporated as part of new knowledge, transformed, and improved. In physics, the general physics, classical physics (in particular electromagnetism and optics), and interdisciplinary physics have great impact on physics in general. These research areas also have the longest lifetime of scientific outputs, and thus the longest duration of impact (from 11 to 14 years on the average, some publications exceeding the average significantly). On the other end of the spectrum is nuclear physics and particle physics, where new research becomes forgotten or fades away after 6–7 years [67]. Clearly, publications coming from insular areas that are not central for other areas of physics have not only smaller impact but also shorter lifespans.

The existence of the clear boundaries between the subfields in physics is a feature of scientific knowledge, not a feature of doing science. The picture of disciplinary boundaries changes when one focuses on scientists and on how they migrate from area to another. According to Battiston et al. [66], most physicist start their careers in the three subfields but do not stay in these areas for all their careers [66,67]. The specialisation in single fields is not a rule of a typical career in physics and the majority of physicists (63%) work in two or more subfields over their career. As found by Battiston et al., only 1% of researchers in interdisciplinary physics are specialised in it, in condensed matter only 42% and in high energy physics and nuclear physics, 34% and 25% respectively. Condensed matter physics is a starting point for many physicists who later work in interdisciplinary or general physics. One reason for this may be the role of statistical physics, which is part of the condensed matter physics cluster and is widely applicable in many other fields. The clusters of high energy and nuclear physics, on the other hand, feed physicists to astrophysics, probably for reasons related to the expertise in radiation physics needed in all these areas. Given that high-energy physics and nuclear physics are among the most closed disciplines, this is an interesting finding. The explanation provided by Battiston et al. is that migration between fields is related to transfer of know-how and methodologies, especially in the case of condensed matter physics, and to skills of working in large teams and on long-term projects, as is typical in high energy physics. Physicists working different subfields apparently combine expertise of those fields, thus facilitating invention of new ideas, combination of ideas and approaches, all features needed for discovery of new ideas [71,72]. In addition, regarding the central roles of condensed matter physics and high energy and nuclear physics as the starting points of careers, Battiston et al. [66] note the historical developments of the research strategy of western countries, which focused on these areas strongly during the 80s. The investments made several decades ago are still structuring institutions and educational systems, although the needs of research have changed since then.

Chemistry provides another interesting example of evolution of subdisciplines, their emergence, waxing and waning or submerging of some special areas into new growing, more dominant areas. A recent study by Waaijer and Palmblad [73] explored how chemistry as a field of research has evolved from 1929 up to 2013 as it appears in one journal, Analytical Chemistry. Although only single journal was used to monitor evolution in chemistry, the relatively broad scope of the journal is assumed to provide useful insight on the development of the field. The study by Waaijer and Palmblad used content sensitive methods, based on detection of key words and they co-occurrence to recognize subdisciplinary areas and their evolution. In the era of focus, in chemistry, as in other natural sciences, the research output increased exponentially. According to Waaijer and Palmblad [73], the most important areas within chemistry in 1929–1940 were related to instruments and apparatus, gases, inorganic chemistry and applications of chemistry. The analytic chemistry, on the other hand, was one of the most important and central areas from 1929 to 1990 but in period 1991–2000 it begun to merge increasingly with electrochemistry and sensor technology. In the early years of 20th century chemistry, gravimetric and volumetric experimental methods have had the most important role in experimentation, gradually shifting to background with advent of new methods, but never completely disappearing; in chemistry, similarly as in physics, old methods do not necessarily die out but are incorporated as routine parts of novel methods, thus becoming invisible.

Topics that have developed over time include electrochemistry, chromatography, and mass spectrometry. From 1941, electrochemistry begins to appear in publications, connected most often to inorganic chemistry and metals, but during 1951–1960, it appears as self-standing subdiscipline. Similar development is found in spectrometric methods, where chromatography begins to stand out from period 1951–1960 onwards, and mass spectrometry after period 1971–1980. Mass spectrometry develops through its connection to chromatography up to 1990, and after that, it forms its own subdiscipline. An example of completely new discipline appearing in 2001 and growing after that is microfluidics,

which is strongly connected to theory and simulations. Consequently, according to Waaijer and Palmblad [73], chemistry as a research field has changed considerably from 1929 to 2012, the major change being the decrease in chemistry based analytical methods and increase of physics based analytical methods, especially the increasing importance of mass spectroscopic methods.

In summary, the analyses of disciplinary structure of science provide ample evidence that to understand nature of science, one needs to pay attention to how disciplinary structures emerge, how borders are crossed and how border crossings shape sciences, how some structures are dissolved and others become insular. Such changes are inherently connected to historical traces of how disciplinary identities are formed and on the other hand, social and political guidance and the rise of new needs to which science needs to attend. One important factor affecting the formation and change of disciplines is the migration of scientists with different know-how on problem solving and use of methods. In short, such factors provide important and concrete evidence of the strong societal factors in doing science and how societal decisions affect the structure of science. Science of Science does not attempt to provide an overall, simplified and streamlined picture of sciences, not even in cases of its disciplinary substructures. Rather, SoS invites us to accept the complexity as a genuine feature of science

4.3. Theory and Empiry: Physics, Chemistry and Biology

The relationship between experimental and theoretical physics provides an interesting viewpoint on the roles of methodological boundaries. The discussion about the experimental-theoretical division in physics is a long-running one, but on quite an informal and subjective basis, and only recently have evidence-based views become possible through scientometric analysis [68]. A study that explored the connections of experimental and theoretical research in physics found that these two fields are very closely connected and the borders between them are easily crossed; there is no deep division between experimental and theoretical physics [68]. The analysis showed that experimental physics and theoretical physics are very tightly connected, with substantive flows of knowledge transgressing the boundaries (but with boundaries existing). In addition, the citation patterns, showing how knowledge is used and distributed, are remarkably similar within and between the areas of experimental and theoretical physics [68]. Interestingly, such homogeneity can perhaps be attributed to a certain similarity in ways of doing science, reporting it and augmenting for knowledge claims; all these features are closely connected to norms and conventions within a discipline.

This picture of relations between theoretical and experimental physics, however, changes when top-cited authors are the focus of attention [74]. In this case, it is clear that the top-cited theorists are much more visible in the literature than experimentalists are. The reason for such a situation is that many key theoretical results are of interest and importance in many other subfields of physics, as is expected in science, which is stratified in the sense that one can recognise a fundamental theoretical knowledge that underpins most of its areas [74]. Curiously, this might also be related to the high visibility of theoreticians in popularising physics and its recent advancements.

A close connection between theory and empiry is found also in chemistry, in particular in its subdisciplinary areas of physical chemistry and analytical chemistry. In physical chemistry, the atomic physics and quantum theory have close connection to experimental research of molecular spectroscopy and reaction kinematics, theory being involved not only in guiding experiments but also in devising new experimental techniques [73,75]. According to Johnson [75], in physical chemistry experimental and theoretical methods are today converging, in particular in modern theoretical methods of quantum many-body systems and computational to investigate chemical bonding [75]. Another research area where on finds rapid convergence of theoretical and empirical methods is found in nanoscience, where the relation between physics and chemistry is close and fluid [76].

Close connection between theory and empiry is perhaps quite expected in physics and chemistry, where mathematisation and use of advanced experimental methods are central and owing to historical development of the disciplines. However, similar convergence of theory and empiry characterise also "softer" science, biology. In biology, in much the same ways as in chemistry and physics, the theoretical models are often mathematical models, which are used to formalise hypotheses, simplify the complexity of phenomena, or integrate phenomena on different temporal and spatial scales. It is also expected in biology that theoretical models can be related to empirically observable phenomena, if not directly, at least at a certain level of abstraction and idealisation [77,78]. A recent survey [78] reported that many researchers in ecology and evolutionary biology think that theoretical and empirical research should be integrated in biology for the advancement and success of the field. However, only a fraction of the biologists share the view that such integration has taken place or been successful, while the vast majority sees theoretical and empirical research as separate and having very little interaction [78]. This view of scientists (view of practicing scientists) was challenged by a recent scientometric study, which shows that in fact the integration and interaction of theoretical and empirical research in biology is more common than might be expected on the basis of the survey. It is evident that in biology (or in the branches of biology explored by the study), the majority of the research is done within subfields (as in physics), but a significant fraction (about 20%) transgresses the boundaries of subdisciplines; there is significant knowledge flow. What is important, is that 60% of research outputs were theory or empiry insular (self-citing only papers that were theoretical or empirical), while 40% integrated theoretical and empirical research. This is more than could be expected from a survey based on the views of practicing biologists. The authors of the study raised the question of why there was such a discrepancy between the views of practicing scientists and the results of scientometric analysis. As one possibility, they recognised the way the theoretical work is used as background and to provide motivational underpinnings for the empirical work, rather than explicitly integrated as part of the empirical work. Another reason pointed out in the study is the role of review-type contributions that explicitly attempt to create bridges between theoretical and empirical work.

When the roles of theory and empiry are compared in physics, chemistry and biology, it is clear that there are certain differences in why theory and empiry are integrated and how the relation of theory to empirical research is conceived. On the other hand, there are many similarities, which arise partly from how the empirical work becomes motivated and guided by theoretical assumptions even in the cases that it does not explicitly integrate theory. In both cases, however, the relationships revealed by scientometric analyses and SoS embody the science philosophers' notion about the theory-ladenness of science. On the other hand, the findings warn against making oversimplified assumption about the primary role of empirical research as the driving force in the advancement of science.

4.4. Cognitive Extent and Knowledge Growth

The volume of scientific knowledge, as measured by the number of publications, reports and other written scientific documents, has increased exponentially over the last century, with a yearly growth rate of 5% (see, e.g., [79]). This, however, does not necessarily mean that new ideas and significant scientific findings, i.e., the cognitive content of science, have increased equally. Here, cognitive content (and content) refers to new concepts, terms, theories, models and such intellectual or artefactual (i.e., devices) that can be recognized by using data gathering methods of SoS [70,80], as outlined in Section 3. Similarly, it is often mentioned that today large collaborative groups are the most significant in producing scientific output (see, e.g., [80–82]). It is claimed that big groups are becoming more common in all areas of science, and also that they are responsible for the main intellectual output of scientific knowledge (see, e.g., [72,81,83]). The high visibility of large groups in producing many scientific reports, however, does not necessarily mean that large groups

also produce the majority of the new ideas and insights, i.e., the new cognitive content of science [70].

The growth in the cognitive content of science and the role of groups of different sizes in production of the new cognitive content has recently been questioned by taking a closer look at how new concepts and ideas are introduced in scientific publication, by using not only citation-based analysis but also deeper textual analysis of content [70]. In an extensive study, Milojevic [70] explored the cognitive content of articles in physics (440,000 articles), astronomy (160,000 articles), and biomedicine (19,600,000 articles), which were published over periods of 117, 125, and 67 years, respectively. The results of the study show that although the growth in productivity in all these research areas was indeed exponential, the cognitive content of the fields increased only linearly rather than exponentially. In all these areas, the growth of cognitive content is within a factor of a few, while the publication volumes rose a hundred- to a thousand-fold [70]. An interesting example of the disconnect between productivity and cognitive progress is provided by physics, where in 1970s the growth in production was low, nearly stagnant, but despite that, it was the period of fastest cognitive growth [70].

The role of groups of different sizes appears also very differently in an analysis based on content, instead of on mere citations. According to Milojevic, in physics and astronomy, the publications by single authors or pairs of authors produce the majority of the cognitive content, and in the case of several authors, more authors indicate less cognitive content. In fact, publications produced by very large teams (i.e., groups working in big science) provide only 35% of the cognitive content of physics. This notion, even when the limitations of the study are taken into account, puts the claims of the dominance of big science groups in a very different perspective. The differences of group size with regard to the cognitive content and its extension can be at least partially understood on the basis of how groups are formed. Formation of small groups, involved with the greatest breadth of cognitive content, appear to follow a random process (Poisson process), while larger groups grow by agglomeration and take advantage of cumulative growth. Large groups are also more specialised than small groups, and thus do not cover the entire research field within their disciplines. It is also evident that small groups focus mostly on theory, and thus are involved in the production of novel conceptualisation. A plausible interpretation is that small groups are involved in producing new concepts, not all of them of lasting value, while big groups are involved in testing and justifying the knowledge, but not taking so many risks in proposing tentative concepts, models and theories.

This interpretation of the different cognitive roles of small and big groups finds support from a study by Wu et al. [84], which analysed 65 million papers, patents and software products from the period 1954–2014 to identify how group size and the introduction of new ideas are correlated. The results show that small groups indeed tend to cause disruptions, by adopting and introducing ideas that are out of the mainstream, whereas big groups develop the existing ideas further. A consequence of focusing on existing mainstream ideas is that the work comes to the attention of others more rapidly, which also explains why research done in large groups and teams gains better visibility. The research done in smaller groups gains attention much later or not at all. The importance of this finding about the different roles of small and big groups is that it guides attention to the need for intellectual diversity and diversity in working modes. The advancement of science needs both kinds of activities, feeding new ideas, not all of them fit for further life, and testing and developing the existing ideas further. In discussing science, it is important to keep in sight such intellectual diversity instead of emphasising the intellectual dominance of big groups and big science, which may result if only volume of productivity and activities are valued.

4.5. Interdisciplinarity and Knowledge Flows

The advantages and disadvantages of the disciplinary structure for advancement of sciences are currently much discussed, with conclusions that favour interdisciplinarity

for the advancement of sciences [62,63,71,82,85,86]. However, the degree to which interdisciplinarity is realized, and even its benefits, are questioned and disputed [87]. It is a common claim that contemporary science is strongly interdisciplinary and disciplinary boundaries are dissolving. However, this claim, if taken at face value as indicating that boundaries are dissolving, fails to find strong support from quantitative research of science. Rather, the overall picture is more complicated, with clear disciplinary structures visible but significant border-crossing between boundaries that remain instead of dissolving [85]. It is thus necessary to acknowledge the diversity and existence of the stratified disciplinary structure in order to understand the role of disciplinary structure, how it emerges from different research strategies and methods, and how it affects the development of research agendas, researchers' careers, and the flow of knowledge.

Disciplinary boundaries and the stratified structure of disciplines, however, do not hinder knowledge flow and diffusion. On the contrary, extensive evidence flowing from Science of Science studies show that strong connections exist between the boundaries, and researchers constantly export and import ideas from one disciplinary area to another [71,82,85,86]. The knowledge flows occur not only between different disciplines; there are significant and important knowledge flows between sciences and areas where their knowledge is consumed. Consequently, researchers of Science of Science have explored such dynamics of knowledge production and consumption from the perspective of the exchange balance of scientific knowledge [88] and also as "food webs" of knowledge; as dynamic networked systems [89].

One of the most studied areas is knowledge flow from science to technology, as it appears through the patent-to-paper citation data. Such connections are interesting because they arise from collaboration between pure sciences and technological industry, on the one hand related to knowledge transfer in practical problem solving and on the other, also closely related to innovation and the commercial success of nations [90–93]. It has been claimed that rapid advancements in information technologies facilitate knowledge diffusion and transfer, and thus effectively diminish the effect of geographic barriers [94]. However, the recent results based on scientometric analysis do not necessarily support so a clear-cut interpretation.

The paths leading to scientific innovations involves bidirectional diffusion of knowledge and knowledge transfer between science and technology. Together, science and technology decide the direction of scientific advancement and progress, and they are inseparable parts of knowledge evolution. The research in Science of Science has provided much information on the paths along which this knowledge diffusion and transfer occurs [95,96]. In a study focusing on knowledge flow paths between science and technology, it was shown that there are significant similarities but also differences between the evolution mechanisms in science and technology.

4.6. Disciplinary Structure at Country Level

The disciplinary structures of sciences exhibit interesting variations from one country to another. For example, the scientific activity of the West European countries has a different disciplinary profile compared to the post-communist countries of Central and Eastern Europe, as well as compared to Asian countries [64,97,98]. Roughly, the Western European pattern of disciplinary structure can be characterized as being strong in clinical medicine and biomedical research, while the post-socialist countries and China are strong in chemistry and physics. However, in the Western European profile it is also possible to find clear biases: for example, the UK is stronger in medical and life science than Germany, while Germany is strong in physical sciences and engineering [64,97]. It has been pointed out that it is possible to recognize historical and ideological reasons behind such developments in disciplinary specialization [64,99]. It is interesting to note that the disciplinary structures of different countries are indeed different, that there is a connection with the cultural and historical heritage of the countries, and change is slow.

Differences in disciplinary profiles are also reported in studies that compare G7 countries to BRICS countries (Brazil, Russia, India, China and South Africa). In the G7 countries, life sciences play the most important role, while in the BRICS countries physics, chemistry, mathematics and engineering are the strong areas of research [61]. The disciplinary structure of European countries is consolidating to a profile with certain identifiable European characteristics, with many developing countries approaching that same profile but some others clearly departing from it [60]. It is obvious that national strategies on investments, including decisions to funnel funds to certain areas in R&D to improve technological competitiveness and the economy, affect the disciplinary profiles, as does the simple fact of geographical location, through its effect on trade and commercial collaboration and competition. Such factors directly affect the disciplinary structure, because the disciplinary structure has a strong effect on competitive positions in economy and technology [58,100].

Some other studies have focused on the interaction and balance of knowledge flows between different countries [88,101], paralleling the studies that have explored the disciplinary structures and profiles in different countries. These studies have pointed out the interesting phenomena of obvious localization; despite the global nature of science and pervasive use of IT technologies, science is still in many respects local. The results of such studies show that geographical distance is quite significant on the national level, and affects the knowledge flow on the continental level as well, but becomes insignificant on the international, intercontinental level. The role of geographic closeness in knowledge flow can be attributed to the importance of direct personal interactions and social effects, like connections with mentors, the effect of schools in the research field, and on the domestic level of biases in citation practices favouring domestic research [88,101]. Other studies have reported similar results, showing that citation links decrease with increasing distance [83,86].

In summary, while the studies of the dynamics of knowledge flows end up with different, if not contradictory results, they open up discussions of the complexity of the knowledge flows and point out how different factors eventually contribute to the formation of the successful paths. This is a clear example of the mutual dependence of science and technology, and how they are both related to the economy and economic competence of nations. Such information is a good starting point for discussions of the societal effect of science and how society affects science.

4.7. Other Topics Covered in SoS That Are of Interest for NOS

Science of Science provides a vast and rich stockpile of information about the disciplinary structure of sciences, detailed maps of subdisciplinary structure, the cognitive content of sciences, community and collaboration structure, interdisciplinarity and transgression of disciplinary boundaries, country-related differences, and knowledge flows. Some of these aspects have been discussed here, but many interesting and important topics of interest that are needed to understand science are yet untouched. Two additional topics that are clearly of interest for NOS and on which SoS provides much information are related to discoveries and institutional practices.

Discoveries and originality of ideas have been the focus of some recent studies [102,103]. One way to detect originality and new ideas rests on textual and citation analysis, on how concepts or ideas are available in previous literature [102]. However, the detection of landmark papers as based on expert opinion does not necessarily support the view that such citation-based analysis is reliable in detecting originality. Consequently, several novel methods to detect originality and novelty have recently been explored.

The institutional practices of distribution of scientific knowledge and securing the reliability of knowledge through different quality control means is another important aspect of science. Peer-review of scientific publications is perhaps the most important single process in securing the quality of scientific outputs. Peer-review, however, is far from unproblematic, and how its internal dynamics may bias the type of results published has been extensively discussed [104]. It may have astonishingly low reliability with regard

to the importance of the results [105]. Interestingly, the peer-review system also affects the formation of research collaboration and networks [106].

The above are only a few examples discussed extensively in the SoS literature, and all of them are quite evidently also of great interest for NOS. Other topics of interest covered in SoS literature are: science and economic growth, funding strategies and policies, scientific careers and career opportunities, and science and entrepreneurship. In addition, topics related to the development of scientific fame and success are of interest for NOS, at least at the level of higher education, in the education of science teachers, when the broad notions contained in NOS are in need of concrete examples and deeper discussion. Therefore, it is highly recommended to use the information provided by SoS to embody the very general and non-specific notions on which NOS is often based.

5. Topics of SoS as Material for NOS Themes

The topics addressed by SoS and the information it provides can be quite well discussed in science education as self-standing topics, from SoS perspective and without connecting them to NOS discussions. However, there are many rather obvious connection points to NOS themes and making such connections may be advantageous. The themes provided by SoS are not meant to replace NOS themes, nor to add new focal points or viewpoints, but to provide information and evidence that can be used to embody the general and idealized notions of NOS. In that, the role of SoS parallels with ways to acknowledge the information based on HPSS scholarship, traditionally having had a central role in NOS, and recent studies about practicing scientists' views [10,11,16–19], which are also acknowledged to be important contribution to NOS [1].

The scholarship in HPSS has already provided and continues to provide embodiments based on historical examples, as well as case studies related contemporary science. Such analyses are invaluable but limited. The examples based on history of science, looking back decades or even centuries, help us to understand how we have arrived at the present stage of sciences, but provide limited insight on current developments and their dynamics. Moreover, HPSS case studies based on contemporary science are often too detailed and too context-dependent (specific examples within a subdiscipline of a certain disciplinary area of science) to provide panoramic pictures at the level of the generalizations needed for NOS.

The practicing scientists' views [10,11,16–19] provide also insights on doing science and how scientists themselves see science. However, the practicing scientists' views cannot be priorized in guiding how NOS sets its goals, because the views lack coherence and are obviously most often personal reflections rather than outcomes of scholarly studies (see, e.g., [1,32,33] as well as [46]). In using information flowing from SoS one encounters a situation paralleling the case of practicing scientists' views, when such information is embedded as part of NOS. The information flowing from SoS should not dominate in setting goals for NOS, but neither, it should not be ignored but embedded. It is important to acknowledge that neither practicing scientists' view nor SoS can have discriminating role in making preferences between different varieties of NOS; it can adopt different underpinnings flowing from different epistemological backgrounds and evaluations of what is central in science, all of them viable. A decision to adopt a certain version of NOS is a question of applicability in level of use of such views, didactical practicality and choice of focus of teaching, not a competition of correct epistemological background thinking about science.

In what follows, I discus how SoS can be utilized as a source of panoramic views and vast amounts of facts about many areas of sciences. The appropriate NOS embeddings of SoS are here discussed through NOS themes as summarized in consensus NOS [1]. This choice is not meant to priorize consensus NOS as a preferred version of NOS. The solution is practical in sense that in the level the uses of SoS to NOS are discussed here, it is unnecessary to underline the differences between consensus NOS and other variants of approaches (like FRA). In parallel with notion that different versions of NOS do not

differ too much in level of education relevant for schools [1,6], it is also concluded here that differences between NOS variants can be ignored on discussing relation of SoS to broad thematic categories of interest in NOS. Consequently, although the embedding of SoS topics to NOS themes is now provided by utilizing categorizations from consensus NOS, similar embedding should be possible for example for FRA or some other version of NOS. Many of the topics that SoS can provide for NOS fall into categories related to disciplinary structure and its dynamics, theory-empiry relationship (including model-based views) and social and institutional factors (e.g., as discussed in FRA, see Erduran and Dagher [22]). As a result, embedding the themes available from SoS to FRA appears rather to restructure NOS themes under the FRA categorizations rather than having significant consequences on how the SoS themes can be utilized if FRA is chosen as preferred approach on NOS. In addition, some factors as they come out from SoS cannot be factorized in such a categorical way as consensus NOS suggests, but this is probably not a problem, because, its categorizations are not meant to be fixed but, at least at a higher level, to form a connected set of themes [1]. Similarly, factors related to the role of models, theories and laws in SoS are not as explicit as introduced in FRA (see Erduran and Dagher [22]). Such knowledge structures as they appear in SoS in different disciplinary areas, can quite well be discussed from model-law-theory viewpoint offered by FRA, but without necessity to pose such structures as an overarching organizing system in disciplinary areas, where such divisions may be difficult to recognize or appear to impose too forced pre-fixed structures (see discussions, e.g., in [44,45]). This flexibility of choices to embed topics from SoS to NOS is result from that SoS is equally indifferent to philosophical and epistemological stances on science as practicing scientist themselves are (see Beebe and Dellsen [46]). This, of course, does not entail that for education NOS should be reduced to descriptions flowing from SoS. On the contrary, different variants of NOS provide valuable lenses to examine and discuss such descriptions.

In what follows, the themes discussed in Section 4 are now aligned with thematic categories of consensus NOS as outlined Abd-el-Khalick [1], from point of view of teacher education. This alignment is summarised in Table 1. In addition, a reference to pre-service students' notions concerning NOS themes, as they are discussed in next Section 6, is provided for better clarity of paralleling the themes. The overlap of categorization in Section 4 (reflecting the themes as discussed in SoS), in Section 5 (reflecting ordering in NOS) and in Section 6 (based on students' notions) is not perfectly aligned, but nevertheless, has much overlap.

Table 1. Alignment of themes as discussed in different Sections 4–6. For Section 6, numbering refers to grouping of pre-service teachers' feedback.

4. SoS	5. NOS	6.
4.1. Disciplinary structure	5.1. Discipl. strct. & knwl. flow (4.1, 4.5)	1,2
4.2. Sub-disciplinary structure	5.2. Durability and change (4.1, 4.2, 4.4)	2
4.3. Theory and empiry	5.3. Theory and empiry (4.3)	2,3
4.4. Cognitive extent	5.4. Creativity and imagination (4.4)	2
4.5. Interdiscplinr. and knowledge flow	5.5. Knowledge flows (4.5)	1
4.6. Disciplinary strct. in country level	5.6. Social and institutional (4.6)	4,5

5.1. Disciplinary Structure and Knowledge Flows

The domain specificity and domain generality of NOS is one of the fault lines discussed already at length at the beginning of NOS movement. As Abd-El-Khalick [1] has argued, the question is largely about the level of sophistication and viability of in-depth discussion at different levels of education: simplified views needed at the school level but increasing sophistication in higher education and science teacher education. Here, we can sidestep problematizing the choice between generality versus domain specificity, and ask how the disciplinary structure of sciences might appear to us if we focused on how knowledge forms disciplinary clusters and how such knowledge flows between the clusters. Finding

out how disciplinary landscapes folds out in such an analysis provides a starting point to discuss how such structures may emerge and what processes might drive both the consolidation and the merging of disciplines. The analyses and findings of the disciplinary structure of sciences as based on SoS (Section 4.1) show that, while the disciplines are to certain degree isolated, there is merging of disciplines and formation of new disciplines on the boundaries of the merging disciplines. Between disciplines, one can find flows of knowledge between the boundaries, as well as within substructures within disciplines. This clearly indicates that, while there is a need to understand the nature of knowledge within disciplines, it is also important to understand the features of knowledge that allow flows of knowledge between disciplinary boundaries. Such features, if not entirely domain-general, need to be general enough to allow the crossing of boundaries on the large scale.

The results based on SoS do not reveal what actually happens at the boundary crossing and what kind of knowledge drives the flows. However, HPSS and PoS analyses and expertise suggest looking at theoretical structures and experimental methods, investigation and reasoning practices that may play key roles in shaping the disciplinary dynamics [107]. From this viewpoint, we can focus attention on how modelling practices and templates of models as parts of these practices cross the boundaries (for example, from physics, mathematics and computer science to fields of biology, economical sciences and even sociology) and templates originating from one branch become adapted and applied in new branches. Such boundary crossings shape the methodological practices and there is certain reciprocity; methodological practices provide identity to disciplines and shape formation of disciplines, but most practices are also born and developed within the disciplines. Similar notions can be made regarding experimental and methodological practices, for example from physics and electrical engineering, computer sciences to medical sciences and biomedical sciences. The number of examples is vast, and cartographic maps of the landscape of sciences provide a rich source of material.

5.2. Durability and Change of Scientific Knowledge

Examples of durability and change of knowledge in contemporary science are available from SoS in some specialised areas of knowledge (e.g., physics). Such discussions are illuminating even if more limited scope than studies within HPSS, which discusses long historical periods and cover different sciences. Examples of durability and change of scientific knowledge as based on HPSS scholarship thus remain invaluable for purposes of science education. Such views cannot be replaced by the findings provided by SoS, but together they may reveal a more complete picture, based not only on history of science but also providing perspectives to contemporary science, of how knowledge evolves and becomes accepted and established. The results of SoS about the subdisciplinary structure of physics and its evolution over the last hundred years shows how the roles of subdisciplines have waxed and waned, borders have shifted and new disciplines have emerged. Science and scientific knowledge are, from this viewpoint, evolving systems, where nothing remains immutable but evolves; new contributions to science produce siblings and gradually become distant ancestors, eventually fading away. In favourable cases (like many branches of classical physics), scientific contributions have long lasting impacts, and features of the initial contributions can be recognized and identified in many new generations. In insular and highly specialized subdisciplinary areas of physics, the lifespan of knowledge, as it can be identified as unchanged or based on identifiable contributions, is shorter. This, however, does not mean that such pieces of knowledge are lost; rather, they have more probably gained new life as part of newer advances. With regard to being identifiable as a durable part of the body of scientific knowledge, classical physics and interdisciplinary physics seem to have certain advantages over modern physics. However, several core contributions of lasting value can be identified in modern physics too.

Thus, far, SoS has focused on identifiable pieces of knowledge through citation analysis and concept-relatedness analysis of publications, and not so much through compiled and consolidated corpora of scientific knowledge, as exemplified by, e.g., monographs,

handbooks and textbooks. This limits the ability of SoS to draw conclusions about how the significance and durability of scientific knowledge evolves in time windows of centuries. However, the temporal evolution of pieces of knowledge already reveals much of the basic dynamics that eventually lead to the stabilization or extinction of scientific knowledge. Moreover, the detailed analyses based on SoS of a hundred years of physics [67], in the era when modern physics became established, provides interesting grounds to discuss the progress of science, either through evolution or more revolutionary instances. SoS rather supporting the former than latter position, although leaving plenty of room for both.

5.3. Theory and Empiry: Confluent or Convergent?

One of the topics discussed in textbooks of science, and especially of physics, is the relation of theory to empirical aspects (empiry) of science. A commonly held view is that theory and empiry are somewhat separate branches, not often interacting and very seldom merging in scientific research. However, as discussed in Section 4.3, this view has been challenged by the results of SoS. In this context, it is also fruitful to discuss, how scientific research is reported: is theory used by empirical research only as a motivational background, without really guiding research, or does it play a more fundamental role in experimental research? Evidence based on SoS as outlined in Section 4.3. May help to form a picture of science in which theory and empiry are seen in a more balanced way: construction of scientific knowledge driven equally by theory and empiry, borders between them being sometimes fluid. In physics, theory and empiry are indeed confluent and tightly interwoven (see Section 4.2). In biology, the situation is more complex; researchers think that there is little integration and that more is needed, while SoS suggests that the integration runs deeper than researchers believe. These topics and how SoS provides material for discussing them seem to fit well into the categories that Abd-El-Khalick [1] calls theory-laden NOS and empirical NOS.

5.4. Creativity, Imagination and Cognitive Content

That creativity and imagination are needed in scientific research may not be obvious at the school level, in particular if a conception of a recipe-like scientific method is taken for granted. At higher levels, however, such views appear to be obvious statements that provide no further insight on how imagination and creativity affect scientific research. Again, HPSS has provided interesting and insightful case studies of highly creative scientists and their contribution on science in history of science. One source that illuminates the role of creativity in contemporary science is found in SoS studies, about the cognitive content of science. The exploration of cognitive content provides information of how novel intellectual contributions appear and in addition, how the introduction of new concepts and ideas correlates with the number of researchers working together (see Section 4.4). These studies show that individual scientists have a significant role in feeding new concepts, and also that small groups of fewer than five scientists are highly productive in suggesting new concepts (and, apparently, new models or adjustments on theory). This provides a good starting point to discuss what happens to all these new inventions—whether they simply disappear, are somehow collated, or just found to be irrelevant. In addition, the studies suggest that the larger the group, more parsimonious the cognitive content of its work. This leads quite naturally to ideas and discussions to explore the role of large research groups in testing and validating knowledge, with the methodological and technological resources they possess. Such discussions have interesting extensions in the division of labour in science (related to the social-institutional factors of NOS and as they are discussed in FRA) as well as in the construction of new theories and their validation and testing.

5.5. Knowledge Flows between Sciences and Technology

Regarding the societal role of sciences, one key theme is how sciences, technology, and technological industries interact, and whether such knowledge flows only from science to technology or in both directions. Studies focusing on role of science in technology are at the

core of science and technology studies (STS) and in this, SoS comes very close to the goals of STS in its attempt to reveal and explore connections between science and technology. In Section 4.5, the knowledge flows between different sciences and between sciences, engineering and technology were discussed. SoS provides many interesting findings on such connections, pointing out the bi-directionality between science and technology. SoS provides strong support for the emergence of technoscience, where technology and science become inseparable and it becomes difficult (and perhaps unnecessary) to make a distinction between them. In big science, it is also common to find transaction zones [107], where science and technology are integrated so that the development of technology need by science is itself part of science, and new and important research problems advance scientific understanding through the development process. Such examples, which are discussed in SoS research but also in STS studies, are invaluable addition to NOS themes, easily finding their place in that framework, either in consensus NOS or FRA.

5.6. Social and Institutional Aspects

The social and institutional aspects of science finds clear actualizations in regional differences in how science is produced and consumed, and how different disciplinary areas are supported in different countries. SoS research has pointed out differences in how hard natural science, physics, and chemistry are more dominant in certain countries, due to their historical and ideological backgrounds, and how sciences supporting industrialization are supported and encouraged in countries seeking economic growth or improvement in technological competition. The correlations between the ideological and political history of a country, its structure of technology, and the focus of its scientific research are a rich source for discussions related to the values and aims of science and how larger scale societal factors affect such values.

Research in SoS has also revealed interesting changes in national distributions of institutions that produce scientific knowledge and that consume it. Some striking examples can be found from developments in European Union and North America (see Section 4.6). Results of SoS point out how the national policies and funding decisions guide research activities, affecting research careers and eventually educational structures and systems. On a local scale, the career paths of researchers reveal a strong dependence on institutional structure and national funding decisions, as shown by detailed studies of physicists' education and employment and their migration from research area to another, as discussed in Section 4.7.

Finally, the accretion of fame in science is one of the most well-known outcomes of the social dynamics within science. As many SoS studies show, there is strong accumulation of fame, leading to recognition of scientists and research contributions that significantly outstrip those of most other scientists and their contributions. Often, of course, such effect is genuinely due to the significance and novelty of the work done, but there is also strong component of fame attracting fame, often also called the Matthew effect [34]. The reasons and outcomes of such an effect, clearly visible in physics (see Section 4.2), provide a starting point for interesting discussions on how personal ambitions to gain fame and recognition are driving forces to do science, and how they might affect the science.

5.7. Possibilities and Options that SoS Opens Up for NOS

The summary of themes in this section (and as discussed in SoS in Section 4) are only a fraction of all the NOS-related items to be found in the fast-expanding SoS literature. The summary repeats the themes discussed in Section 4 with a purpose to show that that topics contained in SoS can be discussed in a framework of consensus NOS themes, as outlined for example Abd-el-Khalick [1], or alternatively, within categorizations provided by FRA. In particular, the way FRA sees role of disciplinary-structure and social-institutional dimensions seems to offer good ground for focused discussions paying attention on disciplinary differences, interdisciplinarity and boundary crossings. Similarly, FRA also provides good scaffoldings to discuss various topics related to social and institutional dimensions. How-

ever, although the starting points of consensus NOS and FRA differ, it is difficult to see insurmountable obstacles to fitting the SoS themes into the categorization within consensus NOS or FRA. This indifference to specific NOS schemes is an important notion because the evidence provided by SoS is based on scientometrics, big-data analysis, and data-mining, not on interpretative analyses based on preferred philosophical viewpoints. As such, it yields to discussions on several alternative viewpoints emerging from HPSS and helps to show that the goal is not to argue for a single correct position but to understand the differences between different positions and to appreciate the multifaceted and rich picture of science they provide. That picture may not be always coherent (no more than practicing scientists' views) but it might be interesting and inspire students' curiosity.

6. Implications for Science Teacher Education

The practical reasons to discuss SoS focusing on topics outlined in Section 4 is to make the science teachers familiar with sources of information contained in SoS and to make them aware what current research in SoS can provide for discussion of features of scientific knowledge, science practices and outputs of scientific research. In that, SoS may also provide material for NOS approaches and discussions of NOS. Similarly, SoS helps to embody the notion of social aspects of science through examples: how scientific communities act, what institutional and social organizations exist and how they operate, how and why scientists meet and discuss, how laboratories are run, what national differences exist and for what reasons, how national policies and agendas affect research, and so on. SoS provides vast amounts of material on all such topics. In addition, instead of using historical examples, as they are available from HPSS, SoS provides a source of contemporary examples. In short, science educators interested in developing NOS and using it as part of their teaching could benefit if they familiarized themselves with SoS to widen the perspectives of NOS.

The context in which SoS was discussed was part (three weeks) of a seven-week course (4 h per week + homework) for physics, chemistry and mathematics teachers in fall semester 2019 in a Finnish University (Faculty of Science). The part of that course involving SoS introduced topics as outlined in Section 4 and reflective discussions were conducted after the introductory lectures in each case. Each week, an article about SoS was provided for study, with a set of questions about the results and views presented in the article. The articles read and discussed were: Battiston et al. 2019 [66], Börner and Scharnhorst 2009 [49], Börner et al. 2006 [83], de Arruda et al. 2018 [68], De Domenico et al. 2016 [36], Herrera et al. 2010 [69], Leydesdorff et al. 2013 [39], Mazloumian et al. 2013 [89], Milojevic 2015, 2014 [70,80], Moya-Anegon and Herrero-Solana 2013 [55], Sinatra et al. 2015 [67], Wu and Wang 2019 [84]. These articles were chosen because they cover the topics discussed in Section 4 broadly enough, without being too specialized research articles. Moreover, these articles make a close contact with physics, chemistry and mathematics, areas which were of the most interest for pre-service science teachers in a faculty of Science. Therefore, the articles chosen were suitable for a course material by their scope, length and depth. The articles by De Domenico et al. [36] and Sinatra et al. [67] were given more attention than the other ones. Students were not asked to familiarize themselves in detail with all material in articles, only parts they found of interest after perusal. The homeworks contained five questions, of which four were simply focused on articles and framed so that they guided attention on topics as outlined in Section 4. In each homework, one question for students was what was new for them and what they found to be the most interesting topics. The feedback reported here is based on that question. The different educational views of NOS were not discussed during the introduction. However, thematic topics as they appear in consensus view of NOS were introduced (but avoiding the special terminology of consensus NOS) and discussed after the three-week period focusing on SoS. In reflection and discussion, however, the facts brought forward by SoS were discussed from the point of view of how they might be related to knowledge and its epistemology in general, as well as the conceptualization and progress of science. Students were free to

discuss the epistemological or science philosophy viewpoints they were familiar with (e.g., inductive and hypothetic deductive positions, realistic or constructivist positions). The lecturer also brought in viewpoints that augmented the students' views or put them in more specific contexts (e.g., versions of realism, constructive or critical, constructive empiricism and different views of the conception of scientific progress etc.). Such additions to the discussion were not planned or predetermined; instead, they were students' spontaneous responses to the directions that the discussion took in reflections. No systematic record was made of these instances.

The topics that were new and interesting for students reveal that, even in an instructional setting that is neutral with respect to philosophical stances and that does not explicitly introduce any tenets or positions for students to adopt with regard to science, one can find that SoS topics guide attention to similar kinds of themes and conclusions that are the backbone of NOS. In what follows, several responses that parallel NOS views are reported. The following is a list of examples of students responses (translated from Finnish).

1. The disciplinary and interdisciplinary structure of sciences.

- I had never before come to think about how much research is being done in science today and how the number of research outputs is growing at such a tremendous rate. Exponential growth was mentioned both in the article and in the lecture.
- I was surprised by how large is the [difference] in the number of studies published in medicine in comparison to physics and chemistry, which I thought would be one of the greatest fields of research.
- The lectures and the article provided a lot of new information about the sizes of different disciplines. I had not thought biomedicine to be so great that it could not be "viewed on the same map" as, for example, mathematics, physics, or the social sciences. [It is] intriguing how the visibility of such a large discipline in the school world is so low.
- The lectures and the literature broadened my understanding ... of sciences, the connections between them, the different "profiles" of scientists, and the whole field of science and the "scope" of different disciplines.
- Before I had not realized that the disciplines are so interlinked as they really are. Significant results in physics are [also] published in non-physics series. Perhaps [we need] to redefine physics. I am wondering whether it is necessary to distinguish (or maintain historical distinctions) between different natural sciences, which, however, describe the same world? [M]ultidisciplinarity has been explicitly sought in modern society. On the other hand, interfaces between disciplines are a natural consequence of the advancement of each discipline.
- An interesting, new thing [was] that research in the field of natural sciences has become more multidisciplinary and focuses on softer themes (life sciences). I welcome this development and believe that with more diverse interdisciplinary co-operation, more significant findings can be made through science.

2. The cognitive content of studies, introduction of new concepts.

- The dependence between the size of the research group and the publication of new concepts [as] presented in the lecture was new. However, it was perfectly reasonable how in physics the curve [of the dependence] was as shown.
- Although publication volumes are growing exponentially, cognitive content is growing linearly, that is interesting. It supports my own observation that the average "additional information" produced by one article has been declining steadily. On the one hand, this makes it almost impossible to follow the new literature, on the other hand, it gives hope that it will possible to keep up with new knowledge.
- The lectures revealed that groups in small scientific communities solve and produce more new [concepts] compared to larger groups. It was interesting to get to see the charts [showing] this.

- The information that new scientific insights often take place among individuals or small research groups is an interesting detail.

3. Cognitive content, theory construction and testing.

- I was also interested in theories of the formation of scientific knowledge. Again, the variety of theories [of formation of scientific knowledge] is surprising. So I would like to know more about the philosophy of doing science, and what, according to different views, is the goal of science.
- It was interesting [to note] that concepts are not eternal, they just have a life cycle and a purpose and eventually they die. Concepts can change over the life cycle.
- I was interested in [the notion that] the same concept can mean different things to different people. When does a concept turn into something different, and when does only its content live in time? Who is entitled to decide? In science, different perceptions arise (hopefully) mainly from different starting points and perspectives.
- Scientific concepts have always been unchanging things for me. Something that has been agreed upon for what it is and then it is just that. It was new to me, therefore, to become aware of ... the evolution of scientific concepts; they expand and converge, their connections to each other change, their purpose evolves, or they can take on a whole new form of presentation. When scientific progress has taken place, developments in concepts have always caused a chain reaction that changes all the concepts associated with the original. Fabulous!

4. Social aspects, scientific activities and scientific communities.

- The social side of science and the examination of the scientific community as part of science aroused my interest and reflection on how strongly science and the scientific community are linked. Can science exist without a community structure?
- I liked a lot [to learn] about the importance of different networking [of scientists], and how to find key people who link [disciplinary] areas to each other.
- The most important aspect is definitely that there is no single answer to the nature of scientific knowledge, but it is a combination of features that depends on both the field of science and the scientific community. Science is also influenced by history, and with the present, it gives direction to the future work of science.

5. Production and consumption of scientific knowledge and role of national policies

- It was interesting to see on which different continents and in which states the creation of scientific knowledge was focused.
- Maps and models of where scientific information is produced... brought a huge increase in perspective to my own perceptions of, for example, how large certain concentrations of scientific knowledge are compared to others.
- I found the various diagrams describing physics as a global phenomenon to be of particular interest — especially what kinds of physics has been studied in different countries. The network of connections between different disciplines also sparked ideas, and it was fun to see how much the different disciplines touch and interact with each other.

6. Other general notions of interest here included.

- Other courses talk a little about measuring the effectiveness of science. This [is] perhaps familiar for researchers through their own academic careers, but for us [pre-service] teacher students, it is interesting information that might otherwise go unnoticed. In the same way, a teacher may not have much knowledge about the big picture and interaction of sciences (networks of sciences). It was interesting to see diagrams of what places and in what research groups science is done.
- I wasn't [aware] of science that explores science itself and that science can be studied, and that it can be so interesting. The new thing was also how difficult it is to define a

researcher's contribution to scientific work. I was [familiar with] studies of the growth of science at different times, but not from this point of view and so widely.

- It was interesting to see how even in scientific research, it is not clear where a researcher will end up and what kind of a research field in their or her career. Research areas within physics, for example, can change radically during the career path. I had assumed that a researcher's career orientation would already be fixed at the training stage. Obviously, this is not often the case.
- During the lectures, my conception strengthened, that science cannot be given an exact definition, but that its nature includes diversity and a certain kind of fragmentation. However, a considerable number of features that are characteristic of science can been identified. I find it interesting how we can identify the features of science and describe what science is like, but still we cannot give a proper definition of science.

The excerpts from the students' responses show that introducing SoS, with minimal additional philosophical interpretations and discussions, but simply as evidential facts and findings, sparks ideas and views that come very close to NOS themes and tenets, but now through spontaneous reflection. They thus offer students a starting point for deeper discussions and considerations how the big picture of science or a more panoramic view builds up if topics are approached from some variety of NOS views, or from perspective of some preferred philosophical stance, e.g., some variety of realistic positions, constructive empiricism or constructivism. Here, and in the course, no preference was made between such views and positions, either related to NOS or philosophy of science. Different views were treated as equally possible and tenable positions, based on chosen emphasis on aspects of interest, which can support the needed flexibility for different rationalizations and different argumentations behind various possible views on science.

Based on the responses to the question of what was new and most interesting in the topics discussed, it appears that the students' factual knowledge of science was weak with regard to many topics: disciplinary structures, how the sciences produce and consume knowledge, and how scientific institutions operate and interact with society. The introduction to SoS and its results may then provide a concrete grounding for more philosophically-oriented discussions, without specifying any particular philosophy of science (constructivistic or realistic or any other) as the preferred and desired view, but to use different views as lenses to reveal different aspects of science and make them conceivable through the given viewpoint. There is then no need to try to find an essence of science, nor closed sets of characteristic features, nor aims and values of science that exist independently beyond the aims and values of scientists, nor norms that are given and which scientists follow, rather than being agreed by scientist and their communities.

7. Discussion

The picture of sciences, its disciplinary structure, substructures, knowledge flows and its internal sociodynamics, as revealed by SoS, is based on textual or lexical analysis of scientific documents. SoS treats such documents as trails to be followed in exploring the evolutionary paths and landscapes of science; it is a cartography of science. Such an approach has the advantage of being evidence-based, obtaining its understanding from analysis of data and records. For science education, a combination of SoS with established approaches in NOS (like consensus NOS and FRA) provides a valuable way to enrich our understand of NOS from complementary perspectives. Results and findings based on SoS are also important ways to extend the HPSS-based views on science in a direction that is more attentive to the large-scale structures of contemporary sciences. NOS provides different lenses or windows to interpret the evidence-based picture of science provided by SoS. While the data that SoS provides is composed of fragments and piecemeal patterns of science based on its practices, activities and products, NOS can provide viewpoints and approaches to construct personal and panoramic pictures, worldviews where the fragments gain value and significance in building a personal picture of science, in accordance with personal convictions and wider worldviews. Such broader perspectives may well be rooted

in certain rationalistic philosophical stances, be they some variety of realism or radical constructivism, materialism or idealism. The goal of NOS is then not to select a correct or best view, or a view best conforming to some philosophical position or the positions of practising scientists, but to evaluate and argue for the chosen view and be able to discuss how the evidence that we have of science supports a particular view.

Interestingly, with regard to practical teaching, the discussion above comes close to the problematics encountered in teaching history. If SoS provides the facts to be discussed and evaluated, and NOS the meta-level viewpoints, a question arises as to which comes first. In teaching history, one is encountered with the situation that, before a deeper understanding is possible, a vast amount of detail must be known and acquired. This is a well-known challenge in learning general history [108,109]. Only when a rich enough knowledge base becomes available does it become possible to start to construct a big picture, a landscape of history, and science history as part of that history. From this vantage point, different versions of NOS naturally provide conceptual scaffoldings, which can then be embodied and enfleshed by the facts and details provided by SoS. The role of the scaffoldings is thus not to provide established, "correct" interpretation of the phenomena, whether history or NOS, but to provide tools to construct arguments supporting one's positions and provide meaning and purpose for the facts so that they can be used to build a personal worldview and set of values.

The feedback received from a teacher education course in which SoS was introduced shows that many views paralleling NOS themes emerge quite spontaneously, even when no attempt was made to use NOS scaffolding as guidance for discussion. This strongly supports the view that NOS would provide a quite natural and viable scaffolding, which is useful and meaningful for guiding and focusing discussion of SoS findings and results. NOS, equally well in form of consensus NOS or FRA, would align quite well with views arising from SoS. Here, however, the course which is reported attempted not to establish explicit connection to NOS. It was, however, important to carry out the pilot version without explicitly using the NOS schemes in order to see whether SoS would resonate spontaneously with such ideas. Now, when the feedback supports this, the next step planned is to develop a course in which NOS issues more explicitly discussed, but only after the SoS findings and results have been introduced. It might be that such a combination of SoS and NOS does not entirely follow how NOS was meant to be used. However, at least for science teacher education, such approach has the advantage of relieving the tensions between NOS and students' initial expectations of how science can be approached through the lenses of NOS.

Finally, it seems that an approach using SoS is also quite viable for school-level teaching. The introduction of the topics discussed in SoS are not so different or so much more complicated than those encountered in history, for example. In teaching and learning history, it has also long been recommended that the it is first necessary to learn facts, temporal ordering and thematizations (here, SoS), and only after that, the interpretations that provide a deeper understanding and a panoramic view of the history (here, NOS-like interpretations). In many ways, history and societal studies are quite natural companions to NOS and better discourse between these school disciplines may benefit both. Both have the tension between factual contents, a vast number of interesting and important details, the kaleidoscopic tendency of facts to arrange in various constellations according to the different viewpoints chosen, and the difficulty of providing meta-level panoramic views, requiring sufficient knowledge about the factual content before a meaningful big picture can be formed.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all students involved in the study. According to regulations of country where study was carried out, approval from an ethical board is not required.

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The author declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SoS	Science of Science
NOS	Nature of Science
FRA	Family Resemblance Approach
PoS	Philosophy of Science
HPS	History and Philosophy of Science
HPSS	History, Philosophy and Sociology of Science
STS	Science and Technology Studies
PSP	Philosophy of Science Practice

References

1. Abd-El-Khalick, F. Examining the Sources for our Understandings about Science: Enduring conflations and critical issues in research on nature of science in science education. *Int. J. Sci. Educ.* **2012**, *34*, 353–374. [CrossRef]
2. Abd-El-Khalick, F.; Bell, R.L.; Lederman, N.G. The nature of science and instructional practice: Making the unnatural natural. *Sci. Educ.* **1998**, *82*, 417–437. [CrossRef]
3. McComas,W.F.; Nouri, N. The nature of science and the Next Generation Science Standards: Analysis and critique. *J. Sci. Teach. Educ.* **2016**, *27*, 555–576. [CrossRef]
4. Olson, J.K. The Inclusion of the Nature of Science in Nine Recent International Science Education Standards Documents. *Sci. & Educ.* **2018**, *27*, 637–660. [CrossRef]
5. Lederman, N.G. Students and Teachers Understanding of the Nature of Science: A Reassessment. *Sch. Sci. Math.* **1986**, *86*, 91–99. [CrossRef]
6. Lederman, N.G. Contextualizing the Relationship Between Nature of Scientific Knowledge and Scientific Inquiry: Implications for Curriculum and Classroom Practice. *Sci. Educ.* **2019**, *28*, 249–267. [CrossRef]
7. Lederman, N.G. Nature of Science: Past, Present, and Future. In *Handbook of Research on Science Education*; Abell, S.K., Lederman, N.G., Eds.; Lawrence Erlbaum Associates, Inc.: Mahwah, NJ, USA, 2007; pp. 831–879.
8. Summers, R.; Abd-El-Khalick, F. Examining the Representations of NOS in Educational Resources. *Sci. Educ.* **2019**, *28*, 269–289. [CrossRef]
9. Galili, I. Towards a Refined Depiction of Nature of Science Applications to Physics Education. *Sci. Educ.* **2019**, *28*, 503–537. [CrossRef]
10. Hodson, D.; Wong, S.L. From the Horse's Mouth: Why scientists' views are crucial to nature of science understanding. *Int. J. Sci. Educ.* **2014**, *36*, 2639–2665. [CrossRef]
11. Hodson, D.; Wong, S.L. Going beyond the consensus view: Broadening and enriching the scope of NOS-oriented curricula. *Can. J. Sci. Math. Tech. Educ.* **2017**, *17*, 3–17. [CrossRef]
12. Jenkins, E.W. The "nature of science" in the school curriculum: The great survivor. *J. Curric. Stud.* **2013**, *45*, 132–151. [CrossRef]
13. Matthews, M.R. Changing the focus: From nature of science (NOS) to features of science (FOS). In *Advances in Nature of Science Research: Concepts and Methodologies*; Khine, M.S., Ed.; Springer: Dordrecht, The Netherlands, 2012; pp. 3–26.
14. Osborne, J. Going beyond the consensus view: A response. *Can. J. Sci. Math. Tech. Educ.* **2017**, *17*, 53–57. [CrossRef]
15. Romero-Maltrana, D.; Benitez, F.; Vera, F.; Rivera, R. The "Nature of Science" and the Perils of Epistemic Relativism. *Res. Sci. Educ.* **2019**, *49*, 1735–1757. [CrossRef]
16. Sandoval, W.A.; Redman, E.H. The Contextual Nature of Scientists' Views of Theories, Experimentation, and Their Coordination. *Sci. Educ.* **2015**, *24*, 1079–1102. [CrossRef]
17. Wong, S.L.; Hodson, D. From the Horse's Mouth: What Scientists Say About Scientific Investigation and Scientific Knowledge. *Sci. Educ.* **2009**, *93*, 109–130. [CrossRef]
18. Wong, S.L.; Hodson, D. More from the Horse's Mouth: What scientists say about science as a social practice. *Int. J. Sci. Educ.* **2010**, *32*, 1431–1463. [CrossRef]
19. Yucel, R. Scientists' Ontological and Epistemological Views about Science from the Perspective of Critical Realism. *Sci. Educ.* **2018** *27*, 407–433. [CrossRef]
20. do Nascimento Rocha, M.; Gurgel, I. Descriptive Understandings of the Nature of Science: Examining the Consensual and Family Resemblance Approaches. *Interchange* **2017**, *48*, 403–429. [CrossRef]
21. Duschl, R.A.; Grandy, R. Two Views About Explicitly Teaching Nature of Science. *Sci. Educ.* **2013**, *22*, 2109–2139. [CrossRef]
22. Erduran, S.; Dagher, Z.R. *Reconceptualising the Nature of Science for Science Education: Scientific Knowledge, Practices and other Family Categories*; Springer: Dordrecht, The Netherlands, 2014.

23. Erduran, S.; Dagher, Z.R.; McDonald, C.V. Contributions of the Family Resemblance Approach to Nature of Science in Science Education: A Review of Emergent Research and Development. *Sci. Educ.* **2019**, *28*, 311–328. [CrossRef]
24. García-Carmona, A.; Acevedo-Díaz, J.A. The Nature of Scientific Practice and Science Education: Rationale of a Set of Essential Pedagogical Principles. *Sci. Educ.* **2018**, *27*, 435–455.
25. Irzik, G.; Nola, R. New Directions for Nature of Science Research. In *International Handbook of Research in History, Philosophy and Science Teaching*; Matthews, M.R., Ed.; Springer: Dordrecht, The Netherlands, 2014; pp. 999–1018.
26. Irzik, G.; Nola, R.A. Family Resemblance Approach to the Nature of Science for Science Education. *Sci. Educ.* **2011**, *20*, 591–607. [CrossRef]
27. Kaya, E.; Erduran, S.; Aksoz, B.; Akgun, S. Reconceptualised family resemblance approach to nature of science in pre-service science teacher education. *Int. J. Sci. Educ.* **2019**, *41*, 21–47. [CrossRef]
28. Rudolph, J.D. Reconsidering the nature of science as a curriculum component. *J. Curr. Stud.* **2000**, *32*, 403–419. [CrossRef]
29. Alters, B.J. Whose nature of science? *J. Res. Sci. Teach.* **1997**, *34*, 39–55. [CrossRef]
30. Alters, B.J. Nature of Science: A Diversity or Uniformity of Ideas? *J. Res. Sci. Teach.* **1997**, *34*, 1105–1108. [CrossRef]
31. Eflin, J.T.; Glennan, S.; Reisch, G. The nature of science: A perspective from the philosophy of science. *J. Res. Sci. Teach.* **1999**, *36*, 107–116. [CrossRef]
32. Schwartz, R.; Lederman, N.G.; Abd-El-Khalick, F. A Series of Misrepresentations: A Response to Allchin's Whole Approach to Assessing Nature of Science Understandings. *Sci. Educ.* **2012**, *96*, 685–692. [CrossRef]
33. Schwartz, R.; Lederman, N. What scientists say: Scientists' views of nature of science and relation to science context. *Int. J. Sci. Educ.* **2008**, *30*, 727–771. [CrossRef]
34. De Solla Price, D.J. The Science of Science. *Bull. At. Sci.* **1965**, *21*, 2–8. [CrossRef]
35. Boyack, K.; Klavans, R.; Börner, K. Mapping the backbone of science. *Scientometrics* **2005**, *64*, 351–374. [CrossRef]
36. De Domenico, M.; Omodei, E.; Arenas, A. Quantifying the diaspora of knowledge in the last century. *Appl. Netw. Sci.* **2016**, *1*, 15. [CrossRef] [PubMed]
37. Fortunato, S.; Bergstrom, C.T.; Börner, K.; Evans, J.A.; Helbing, D.; Milojević, S.; Petersen, A.M.; Radicchi, F.; Sinatra, R.; Uzzi, B.; et al. Science of science. *Science* **2018**, *359*, e0185. [CrossRef] [PubMed]
38. Klavans, R.; Boyack, K.W. Toward a consensus map of science. *J. Am. Soc. Inf. Sci. Tech.* **2009**, *60*, 455–476. [CrossRef]
39. Leydesdorff, L.; Carley, S.; Rafols, I. Global maps of science based on the new Web-of-Science categories. *Scientometrics* **2013**, *94*, 589–593. [CrossRef]
40. Leydesdorff, L.; Rafols, I. Interactive overlays: A new method for generating global journal maps from Web-of-Science data. *J. Informetr.* **2012**, *6*, 318–332. [CrossRef]
41. Leydesdorff, L.; Rafols, I. A global map of science based on the ISI subject categories. *J. Am. Soc. Inf. Sci. Tech.* **2009**, *60*, 348–362. [CrossRef]
42. Smith, M.U.; Lederman, N.G.; Bell, R.L.; McComas, W.F.; Clough, M.P. How Great Is the Disagreement about the Nature of Science: A Response to Alters. *J. Res. Sci. Teach* **1997**, *34*, 1101–1103. [CrossRef]
43. Allchin, D. Evaluating knowledge of the nature of (whole) science. *Sci. Educ.* **2011**, *95*, 518–542. [CrossRef]
44. Boumans, M.; Leonelli, S. Introduction: On the Philosophy of Science in Practice. *J. Gen. Philos. Sci.* **2013**, *44*, 259–261. [CrossRef]
45. Ankeny, R.; Chang, H.; Boumans, M.; Boon, M. Introduction: Philosophy of science in practice. *Eur. J. Philos. Sci.* **2011**, *1*, 303–307. [CrossRef]
46. Beebe, J.R.; Dellsén, F. Scientific Realism in the Wild: An Empirical Study of Seven Sciences and History and Philosophy of Science. *Philos. Sci.* **2020**, *87*, 336–364. [CrossRef]
47. Heckler, W.S. Research on student learning in science: A wittgensteinian perspective. In *International Handbook of Research in History, Philosophy and Science Teaching*; Matthews, M.R., Ed.; Springer: Dordrecht, The Netherlands, 2014.
48. Garfield, E. Citation indexes for science: A new dimension in documentation through association of ideas. *Science* **1955**, *122*, 108–111. [CrossRef] [PubMed]
49. Börner, K.; Scharnhorst, A. Visual conceptualizations and models of science. *J. Informetr.* **2009**, *3*, 161–172. [CrossRef]
50. Zeng, A.; Shen, Z.; Zhou, J.; Wu, J.; Fan, Y.; Wang, Y.; Stanley, H.E. The science of science: From the perspective of complex systems. *Phys. Rep.* **2017**, *714–715*, 1–73. [CrossRef]
51. Kuhn, T.S. *The Structure of Scientific Revolutions*, 1st ed.; University of Chicago Press: Chicago, IL, USA, 1962.
52. Kuhn, T.S. *The Road Since Structure*; University of Chicago Press: Chicago, IL, USA, 2000.
53. Hoyningen-Huene, P. *Reconstructing Scientific Revolutions*; University of Chicago Press: Chicago, IL, USA, 1993.
54. Gattei, S. *Thomas Kuhn's Linguistic Turn and the Legacy of Logical Empiricism*; Routledge: Oxon, UK, 2016.
55. Moya-Anegon, F.; Herrero-Solana, V. Worldwide topology of the scientific subject profile: A macro approach in the country level. *PLoS ONE* **2013**, *8*, e83222. [CrossRef]
56. Waltman, L.; Van Eck, N.J. A new methodology for constructing a publication-level classification system of science. *J. Am. Soc. Inf. Sci. Tech.* **2012**, *63*, 2378–2392. [CrossRef]
57. Aksnes, D.W.; Leeuwen, T.N.V.; Sivertsen, G. The effect of booming countries on changes in the relative specialization index (rsi) on country level. *Scientometrics* **2014**, *101*, 1391–1401. [CrossRef]
58. Li, N. Evolutionary patterns of national disciplinary profiles in research: 1996–2015. *Scientometrics* **2017**, *111*, 493–520. [CrossRef]
59. Vinkler, P. Structure of the scientific research and science policy. *Scientometrics* **2018**, *114*, 737–756. [CrossRef]

60. Bongioanni, I.; Daraio, C.; Ruocco, G. A quantitative measure to compare the disciplinary profiles of research systems and their evolution over time. *J. Informetr.* **2014**, *8*, 710–727. [CrossRef]
61. Yang, L.Y.; Yue, T.; Ding, J.L.; Han, T. A comparison of disciplinary structure in science between the G7 and the BRIC countries by bibliometric methods. *Scientometrics* **2012**, *93*, 497–516. [CrossRef]
62. Porter, A.; Rafols, I. Is science becoming more interdisciplinary? Measuring and mapping six re-search fields over time. *Scientometrics* **2009**, *81*, 719–745. [CrossRef]
63. Porter, A.L.; Roessner, D.J.; Heberger, A.E. How interdisciplinary is a given body of research? *Res. Eval.* **2008** *17*, 273–282. [CrossRef]
64. Ding, J.; Ahlgren, P.; Yang, L.; Yue, T. Disciplinary structures in Nature, Science and PNAS: Journal and country levels. *Scientometrics* **2018**, *116*, 1817–1852. [CrossRef]
65. Shu, F.; Dinneen, J.D.; Asadi, B.; Julien, C.-A. Mapping science using Library of Congress Subject Headings. *J. Informetr.* **2017**, *11*, 1080–1094. [CrossRef]
66. Battiston, F.; Musciotto, F.; Wang D.; Barabási, A.-L.; Szell, M.; Sinatra, R. Taking census of physics. *Nat. Rev. Phys.* **2019**, *1*, 89. [CrossRef]
67. Sinatra, R.; Deville, P.; Szell, M.; Wang, D.; Barabási, A.-L. A century of physics. *Nat. Phys.* **2015**, *11*, 791–796. [CrossRef]
68. de Arruda, H.F.; Comin, C.H.; da Costa, L.F. How integrated are theoretical and applied physics? *Scientometrics* **2018**, *116*, 1113–1121. [CrossRef]
69. Herrera, M.; Roberts, D.C.; Gulbahce, N. Mapping the Evolution of Scientific Fields. *PLoS ONE* **2010**, *5*, e10355. [CrossRef]
70. Milojevic, S. Quantifying the cognitive extent of science. *J. Informetr.* **2015**, *9*, 962–973. [CrossRef]
71. Foster, J.G.; Rzhetsky, A.; Evans, J.A. Tradition and innovation in scientists' research strategies. *Am. Soc. Rev.* **2015**, *80*, 875–908. [CrossRef]
72. Uzzi, B.; Mukherjee, S.; Stringer, M.; Jones, B. Atypical combinations and scientific impact. *Science* **2013**, *342*, 468–472. [CrossRef] [PubMed]
73. Waaijer, C.J.F.; Palmblad, M. Bibliometric Mapping: Eight Decades of Analytical Chemistry, With Special Focus on the Use of Mass Spectrometry. *Anal. Chem.* **2015**, *87*, 4588–4596. [CrossRef]
74. Strumia, A.; Torre, R. Biblioranking fundamental physics. *J. Informetr.* **2019**, *13*, 515–539. [CrossRef]
75. Johnson, M.A. Experiment and theory in harmony. *Nat. Chem.* **2009**, *1*, 8–9. [CrossRef] [PubMed]
76. Marcus, R.A. Interaction of theory and experiment: Examples from single molecule studies of nanoparticles. *Philos. Trans. R. Soc. A* **2010**, *368*, 1109–1124. [CrossRef]
77. Fitzpatrick, C.L.; Hobson, E.A.; Mendelso, T.C.; Rodriguez, R.L.; Safran, R.J.; Scordato, E.S.C.; Servedio, M.R.; Stern, C.A.; Symes, L.B.; Kopp, M. Theory Meets Empiry: A Citation Network Analysis. *BioScience* **2018**, *68*, 805–812. [CrossRef]
78. Haller, B.C. Theoretical and empirical perspectives in ecology and evolution: A survey. *BioScience* **2014**, *64*, 907–916. [CrossRef]
79. Bornmann, L.; Mutz, R. Growth rates of modern science: A bibliometric analysis based on the number of publications and cited references. *J. Assoc. Inf. Sci. Tech.* **2015**, *66*, 2215–2222. [CrossRef]
80. Milojevic, S. Principles of scientific research team formation and evolution. *Proc. Natl. Acad. Sci. USA* **2014**, *111*, 3984–3989. [CrossRef] [PubMed]
81. Wuchty, S.; Jones, B.F.; Uzzi, B. The increasing dominance of teams in production of knowledge. *Science* **2007**, *316*, 1036–1039. [CrossRef]
82. Jones, B.F.; Wuchty, S.; Uzzi, B. Multi-university research teams: Shifting impact, geography, and stratification in science. *Science* **2008**, *322*, 1259–1262. [CrossRef]
83. Börner, K.; Penurnarthy, S.; Meiss, M.; Ke, W. Mapping the diffusion of information among major U.S. research institutions. *Scientometrics* **2006**, *68*, 415–426. [CrossRef]
84. Wu, L.; Wang, D.; Evans, J.A. Large teams develop and small teams disrupt science and technology. *Nature* **2019**, *566*, 378–396. [CrossRef]
85. McLevey, J.; Graham, A.V.; McIlroy-Young, R.; Browne, P.; Plaisance, K.S. Interdisciplinarity and insularity in the diffusion of knowledge: An analysis of disciplinary boundaries between philosophy of science and the sciences. *Scientometrics* **2018**, *117*, 331–349. [CrossRef]
86. Pan, R.; Sinha, S.; Kaski, K.; Saramäki, J. The evolution of interdisciplinarity in physics research. *Sci. Rep.* **2012**, *2*, 551. [CrossRef] [PubMed]
87. Jacobs, J.A. *Defense of Disciplines: Interdisciplinarity and Specialization in the Research University*; University of Chicago Press: Chicago, IL, USA, 2013.
88. Abramo, G.; D'Angelo, C.A.; Carloni, M. The balance of knowledge flows. *J. Informetr.* **2019**, *13*, 1–9. [CrossRef]
89. Mazloumian, A.; Helbing, D.; Lozano, S.; Light, R.P.; Börner, K. Global Multi-Level Analysis of the "Scientific Food Web". *Sci. Rep.* **2013**, *3*, 01167. [CrossRef]
90. Ding, C.G.; Hung, W.-C.; Lee, M.-C.; Wang, H.-J. Exploring paper characteristics that facilitate the knowledge flow from science to technology. *J. Informetr.* **2017**, *11*, 244–256. [CrossRef]
91. Sorenson, O.; Fleming, L. Science and the diffusion of knowledge. *Res. Policy* **2004**, *33*, 1615–1634. [CrossRef]
92. Tijssen, R.J.W. Global and domestic utilization of industrial relevant science: Patent citation analysis of science—Technology interactions and knowledge flows. *Res. Policy* **2001**, *30*, 35–54. [CrossRef]

93. Tijssen, R.J.W. Is the commercialisation of scientific research affecting the production of public knowledge?: Global trends in the output of corporate research articles. *Res. Policy* **2004**, *33*, 709–733. [CrossRef]
94. Ding, W.W.; Levin, S.G.; Stephan, P.E.; Winkler, A.E. The impact of information technology on academic scientists' productivity and collaboration patterns. *Manag. Sci.* **2010**, *56*, 1439–1461. [CrossRef]
95. Kostoff, R.N.; Schaller, R.R. Science and technology roadmaps. *IEEE Trans. Eng. Manag.* **2001**, *48*, 132–141. [CrossRef]
96. Xu, H.; Winnink, J.; Yue, Z.; Liu, Z.; Yuan, G. Topic-linked innovation paths in science and technology. *J. Informetr.* **2020**, *14*, 101–114. [CrossRef]
97. Glänzel, W.; Debackere, K.; Meyer, M. 'Triad' or 'tetrad'? On global changes in a dynamic world. *Scientometrics* **2008**, *74*, 71–88. [CrossRef]
98. Kozlowski, J.; Radosevic, S.; Ircha, D. History matters: The inherited disciplinary structure of the post-communist science in countries of central and Eastern Europe and its restructuring. *Scientometrics* **1999**, *45*, 137–166. [CrossRef]
99. Radosevic, S.; Yoruk, E. Are there global shifts in the world science base? Analysing the catching up and falling behind of world regions. *Scientometrics* **2014**, *101*, 1897–1924. [CrossRef]
100. Harzing, A.W.; Giroud, A. The competitive advantage of nations: An application to academia. *J. Informetr.* **2014**, *8*, 29–42. [CrossRef]
101. Abramo, G.; D'Angelo, C.A.; Di Costa, F. The role of geographical proximity in knowledge diffusion, measured by citations to scientific literature. *J. Informetr.* **2020**, *14*, 101010. [CrossRef]
102. Shibayama, S.; Wang, J. Measuring originality in science. *Scientometrics* **2020**, *122*, 409–427. [CrossRef]
103. Tahamtan, I.; Bornmann, L. Creativity in science and the link to cited references: Is the creative potential of papers reflected in their cited references? *J. Informetr.* **2018** *12*, 906–930. [CrossRef]
104. Petersen, A.M. Megajournal mismanagement: Manuscript decision bias and anomalous editor activity at PLOS ONE. *J. Informetr.* **2019**, *13*, 100974. [CrossRef]
105. Jirschitzka, J.; Oeberst, A.; Göllner, R.; Cress, U. Inter-rater reliability and validity of peer reviews in an interdisciplinary field. *Scientometrics* **2019**, *113*, 1059–1092. [CrossRef]
106. Dondio, P.; Casnici, N.; Grimaldo, F.; Gilbert, N.; Squazzoni, F. The "invisible hand" of peer review: The implications of author-referee networks on peer review in a scholarly journal. *J. Informetr.* **2019**, *13*, 708–716. [CrossRef]
107. Galison, P. *Image and Logic: A Material Culture of Microphysics*; University of Chicago Press: Chicago, IL, USA, 1997.
108. van Boxtel, C.; van Drie, J. "That's in the Time of the Romans!" Knowledge and Strategies Students Use to Contextualize Historical Images and Documents. *Cogn. Instr.* **2012**, *30*, 113–145. [CrossRef]
109. van Drie, J.; van Boxtel, C. Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educ. Psych. Rev.* **2008**, *20*, 87–110. [CrossRef]

education sciences

MDPI

Article

Science Teachers' Perceptions and Self-Efficacy Beliefs Related to Integrated Science Education

Outi Haatainen *, Jaakko Turkka and Maija Aksela

Unit of Chemistry Teacher Education, Department of Chemistry, University of Helsinki, 00100 Helsinki, Finland; jaakko.turkka@helsinki.fi (J.T.); maija.aksela@helsinki.fi (M.A.)

* Correspondence: outi.haatainen@helsinki.fi

Abstract: To understand how integrated science education (ISE) can be transferred into successful classroom practices, it is important to understand teachers' perceptions and self-efficacy. The focus of this study is twofold: (1) to understand how teachers perceive ISE and (2) to assess if science teachers' perceptions of and experiences with integrated education correlate with their views on self-efficacy in relation to ISE. Ninety-five Finnish science teachers participated in an online survey study. A mixed method approach via exploratory factor analysis and data-driven content analysis was used. Self-efficacy emerged as a key factor explaining teachers' perceptions of and their lack of confidence in implementing ISE as well as their need for support. In addition, teachers regarded ISE as a relevant teaching method, but challenging to implement, and teachers primarily applied integrated approaches irregularly and seldom. Furthermore, teachers' experiences with integrated activities and collaboration correlated with their views on integrated education and self-efficacy. These findings indicate teachers need support to better understand and implement ISE.

Keywords: integrated science education; interdisciplinary education; self-efficacy; teachers' perceptions; teacher training

Citation: Haatainen, O.; Turkka, J.; Aksela, M. Science Teachers' Perceptions and Self-Efficacy Beliefs Related to Integrated Science Education. *Educ. Sci.* **2021**, *11*, 272. https://doi.org/10.3390/educsci11060272

Academic Editors: Kirsi Tirri and James Albright

Received: 5 May 2021
Accepted: 26 May 2021
Published: 31 May 2021

1. Introduction

Science teachers have a pivotal role in integrating new research and science education reforms into classroom practices. Their beliefs and perceptions about integrated science education (ISE) should be considered as the change agent in such situations [1–6]. ISE is an effort to integrate science curriculum contents into a meaningful whole by a constructive and context-based approach that crosses subject boundaries and links learning to the real world [7,8]. It is a current issue of focus among researchers due to the many promises it offers, such as giving pupils a more coherent understanding of complex everyday life phenomena, increasing conceptual understanding, developing students' 21st-century skills (e.g., critical thinking and problem-solving skills) and increasing students' interest in school and science subjects [7,9–14]. Due to the possibilities, recent policy reforms [15,16] across the globe tend to emphasise the need for more integrated approaches to science education [7,17].

Implementing more integrated approaches to science education, especially approaches that push beyond traditional science subjects, presents teachers with multiple barriers to overcome. The challenges include, for example, pedagogical, curriculum and structural challenges; concerns about students and assessment; a lack of teacher support [5,18,19]; as well as challenges related to the broad range of ways of defining and implementing integration [7,20–22], for example as Science, Technology, Engineering and Mathematics (STEM) education [17] or Science, Technology, Society, and Environment (STSE) education [23].

In a scenario involving challenging educational reforms, teachers' self-efficacy and their perceptions are likely to become important aspects of everyday science teaching practice [24,25], which can potentially explain some of the phenomena observed in science education associated with teachers' resistance to reforms [26,27]. One resulting problem is

providing teachers with a new curriculum without addressing the underlying educational belief systems, which are dependent on various factors, including prior experiences as well as self-efficacy, and which can lead to little meaningful change [27–29].

Tschannen-Moran and Hoy [25] have defined teachers' self-efficacy as a future-oriented belief about the level of competence a person expects he/she will display in a given educational situation. Such beliefs influence the courses of action teachers choose to take, their level of effort, their perseverance in the face of obstacles and what they ultimately accomplish [30]. As self-efficacy beliefs are context-related and dependent on perceptions of the desired outcomes [30], it follows that teachers' perceptions of ISE and their experience with implementing an integration approach influence their self-efficacy belief in ISE. However, science teachers' perceptions regarding integration and the need for integration vary [5,31,32], and research evidence on science teachers' self-efficacy for ISE is not comprehensive.

This mixed method research project began with a focus on science teachers' perceptions of ISE, but the strong emphasis on self-efficacy encouraged researchers to explore it as a research question in its own right, one with links to teachers' experiences and perceptions of ISE. Three research questions were asked:

- How do science teachers perceive ISE?
- How do science teachers perceive their self-efficacy in relation to ISE?
- Do science teachers' self-efficacy beliefs about ISE correlate with their experiences with and perceptions of ISE?

The data for this survey were collected at a time when integrated education policies were first being introduced to Finnish educational systems, thus it offers insights on a situation of lower self-efficacy related to challenging curriculum reforms for both primary and secondary school science teachers.

1.1. Integrated Science Education in Finnish Education System

For the first time, the national curriculum in Finland dictates primary and lower secondary schools to organise yearly a multidisciplinary learning module. The schools are obligated to plan and implement these 'tools for integrating learning and for increasing the dialogue between different subjects' in cooperation between different subjects and to involve pupils in their planning [15]. Furthermore, integrated elements are impeded in the learning goals of individual subjects.

The Finnish curriculum offers a broad definition of integrated education that emphasises, among other things, the development of the whole person (social, affective, cognitive), the integrity of subject matter knowledge and the use of interdisciplinary teaching [15]. It is closely linked to context-based education [33], as it aims to link subject matter with relevant contexts from students' everyday lives and society. Furthermore, the curriculum has similar principles guiding it as the framework for K-12 science education [16], but with one distinction: in Finland, instead of cross-cutting concepts, the emphasis is on crosscutting skills, called transversal competencies, which can be achieved through integrated education.

The science curriculum is organised and taught as separate subjects in Finland from lower secondary school (7th grade) onwards. The National Core Curriculum provides a common direction and objectives for school education, but teachers have pedagogical autonomy. They can decide themselves the methods of teaching as well as textbooks and materials [34]. Due to the pedagogical autonomy of Finnish teachers, their perceptions of ISE can have a considerable effect on the integrated practices.

2. Theoretical Background

The main aspects of integrated education are drawn from Dewey's [35,36] concepts of school as a society in miniature, where learning is student-centred and based on real life and authentic activities and the aim is to teach skills and provide knowledge relevant to the learners as individuals and members of society. However, the current discourse

on integrated education is a contested one, with various typologies and terms that are sometimes used interchangeably [7,14,22,37].

The forms of integration can be defined by the degree of transfer or connection being made between contents or disciplines. Transfer of learning can be described as the ability to apply what one has learned in one situation to a different situation [38,39]; therefore, it can be seen as the main goal of integrated education, which aspires to teach the skills and knowledge needed in real life. Four terms widely used to describe integrated approaches, ranging from least to greatest level of integration, include integration within the subject, multidisciplinary approaches, interdisciplinary approaches and transdisciplinary approaches.

- Integration *within the subject* focuses on the integrity of subject matter knowledge [40].
- *Multidisciplinary* approaches juxtapose disciplines, adding information and methods from other disciplines [21,22], while still retaining the elements of each discipline and thereby keeping them somewhat separate. Choi and Pak [41] define multidisciplinary teaching as drawing on knowledge from different disciplines while still maintaining the boundaries between them. A similar concept is correlated curricula [20] and Hurley's [40] notion of sequenced and parallel integration.
- *Interdisciplinary* approaches go further and are characterised by interacting with, blending and linking different disciplines [21,22]. Lederman and Niess [42] define interdisciplinary education as a blending of different subjects by making connections between them, but still retaining the subjects as identifiable entities. Choi and Pak [41] push the idea of transfer further by stating that interdisciplinarity analyses, synthesises and harmonises the links between disciplines into a coordinated and coherent whole. Related terms used by different authors include Dillon's [43] pedagogy of connections [43], shared curricula by Applebee et al. [20] and Hurley's [40] partial and enhanced integration [40].
- The greatest degree of integrative restructuring is associated with *transdisciplinary* approaches [21], which integrate the natural, social and health sciences in a humanities context and allow them to transcend their traditional boundaries [41]. This can go as far as breaking down traditional disciplinary boundaries and reconstructing curricula based on cross-cutting concepts. The central idea is also included in the terms reconstructed curricula by Applebee et al. [20] or Beane's [8] curriculum integration.

Science integration has traditionally meant integration having to do with mathematics, engineering and/or technology, such as STS (science–technology–society) or STEM (science–technology–engineering–mathematics) education [7,9]. During the past decade, increasing interest has been shown in taking a broader approach to science integration, for example, a move to STEAM education by including art in STEM [14,17]. Indeed, some evidence supports the inclusion of artistic processes in science as they can promote students' conceptual understanding, attitude towards science, involvement in science learning [12] and enable a more realistic transdisciplinary learning experience [44]. However, an agreed understanding about the nature and definition of STEM does not exist [17,45], evidence on learning outcomes in STEAM education are lacking [46], and science teachers struggle with the use of these integrative methods [18,32,45].

2.1. Teachers' Perceptions and Beliefs about ISE

Research findings indicate a strong relationship between teachers' educational beliefs, perceptions and teaching practices [28,29]. For example, teachers' attitude towards reforms or their beliefs about the necessity of reforms is amongst the strongest predictors of the extent to which such reforms would be implemented in the classroom [27,45,47]. However, even when a teacher holds a constructivist and inquiry-driven belief in science teaching, oftentimes those beliefs do not translate into correlated practices [28]. Pajares [29] described teachers' educational belief system as composed of various educational beliefs connected to one another, and it is according to these connections that beliefs are prioritized and have context-specific effects. Therefore, having conflicting educational beliefs, such as

subject matter beliefs and self-efficacy, can constrain teachers from implementing even positively valued reforms [28,48]. In this study, we focus on the connection between teachers' experiences of ISE, their perceptions of implementing ISE and their self-efficacy beliefs in relation to ISE.

Teachers' Perceptions of Implementing ISE

Teachers seem to value ISE [5,7]; however, their perceptions on the effectiveness of integrated approaches are mixed [7]. Studies have determined several barriers reported by teachers implementing integrated approaches to science education [5,18,19,24,31,49]. For example, evidence suggests that teachers who perceive more time constraints use fewer inquiry-based strategies [7,49], whereas, contrastingly, teachers who perceive less pressure at work are more likely to implement student-centred approaches [50]. The challenges to integration include scheduling restraints, which make it difficult for teachers to work together or integrate their teaching [5,19]. Furthermore, asking teachers to teach another subject may create new knowledge gaps and challenges for teachers, exposing holes in their own understanding of subject matter knowledge, pedagogical knowledge and interdisciplinary issues [19]. According to Margot and Kettler [5], teachers' prior experiences with integration affect their perceptions and willingness to implement ISE. Therefore, challenging experiences with ISE may hinder teachers from implementing it in the future.

2.2. Teachers' Self-Efficacy in Relation to ISE

Bandura [30] defines perceived self-efficacy as belief in one's capabilities to organise and execute the courses of action required to produce certain educational attainments [30]. Science teachers' self-efficacy beliefs affect their general orientation toward science education as well as their behaviour in the classroom [25,29,30]. Teachers with higher perceptions of self-efficacy are more likely to perceive challenges associated with a specific teaching task, such as ISE, as surmountable, and therefore, they remain more committed to continue executing the task [25,30]. High-efficacy science teachers include students' problem-solving and logical thinking skills in a real-life context, they depend less on curriculum guidelines, they use themes to integrate science into other subjects and they emphasise hands-on science experiences [51]. Teachers with lower efficacy favour a custodial orientation that takes a pessimistic view of student motivation, emphasises control of classroom behaviour through strict regulations and relies on extrinsic inducements and negative sanctions to motivate students to study [30,51].

Teachers' self-efficacy is a context-specific judgment [30]. Therefore, science teachers' self-efficacy beliefs can vary from one integrated teaching situation to another. More research is needed to better understand teachers' self-efficacy for ISE. Bandura [30] identified mastery experiences as one of the main sources of self-efficacy, along with vicarious experiences, verbal persuasion and emotional and physiological states. Most teachers have little experience with integrated approaches to science education, especially beyond science subjects [7,31]. Furthermore, teachers have reported a lack of vicarious experiences as well as support from school and colleagues [5,19,31].

3. Methodology

Both qualitative and quantitative methods were used in this study to better understand science teachers' perceptions of ISE and of self-efficacy in relation to ISE (see Figure 1). The research was data-driven and started with mapping out common denominators for science teachers' perceptions via Exploratory Factor Analysis (EFA). The identified factor solution was used as a thematic aid when conducting content analysis of the open-ended questions about how best to define IE and the possibilities and challenges of implementing ISE. Researchers also gathered together the quantitative descriptive data about the science teachers and their experiences with ISE.

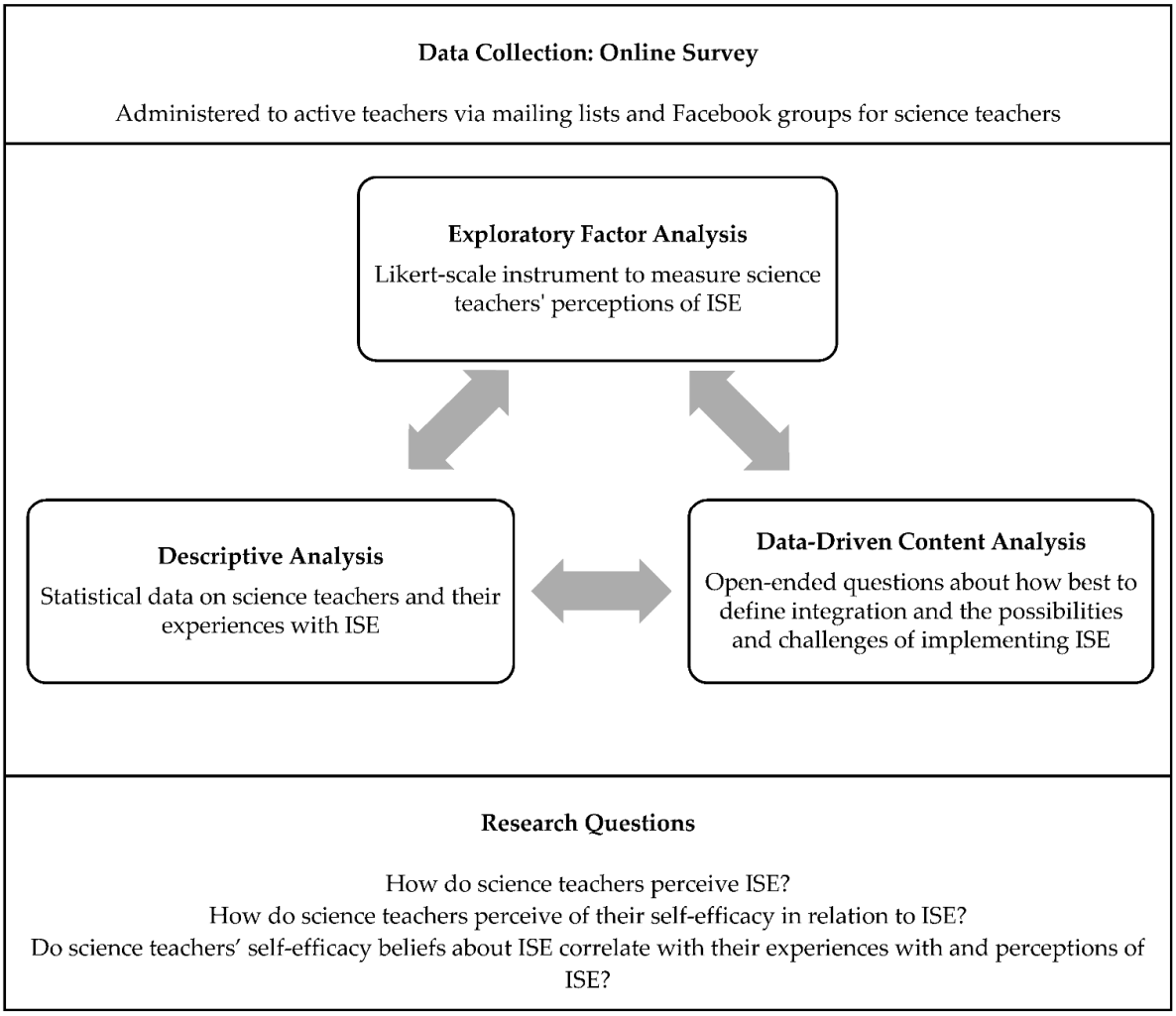

Figure 1. Mixed method research approach was used in this study.

3.1. Survey Instrument

As described in Figure 1, survey was used as a data collection method. An online survey was administered to Finnish teachers via mailing lists and Facebook groups for science teachers on the eve of a curriculum change (see Section 1.1), in November 2015. The questionnaire was constructed with quantitative and qualitative questions to measure teachers' perceptions of integrated education and the implementation of ISE as well as their teaching experiences with it. Measures included background structured questions, open-ended questions and a five-point Likert-scale instrument with 31 ISE-related items measuring degree of agreement, ranging from five 'strongly agree' to one 'strongly disagree' and an additional 'I don't know' option. The instrument items were formulated based on earlier research on ISE [7,24,40,47]. Two fellow science education researchers examined the face validity of the survey. A pilot test followed by discussions with a few pre-service teacher students was conducted, resulting in minor changes to the survey.

3.2. Participants

Ninety-five Finnish science teachers took part in the survey. Excluding seven mathematics teachers, all respondents taught one or two science disciplines (physics, chemistry, biology or geography). The disciplines were often coupled with teaching mathematics. A comparison of the number of teachers in basic and general upper secondary education in Finland in 2016 and in the survey (94.7% of the respondents) are presented in Table 1.

This study does not represent the teachers in vocational or liberal education as only a few respondents identified themselves as teachers in vocational or liberal education.

Table 1. Number of science and mathematics teachers in basic and general upper secondary education in Finland and in the survey (respondents). Numbers shown per primary taught subject.

	Number of Teachers in Finland [1]	Respondents	Respondents (% of Teachers)
Basic education [2]			
Mathematics or data science	1677	32	1.91
Science [3]	1310	25	1.91
Other	23,659	11 [4]	0.05
Total	26,646	68	0.26
General upper secondary education			
Mathematics or data science	760	10	1.32
Science [3]	678	12	1.77
Other	3779	0	0.00
Total	5217	22 [5]	0.42

[1] Source: Vipunen–Education Statistics Finland (https://vipunen.fi/en-gb/, accessed on 25 November 2020). Personnel, statistical year 2016, survey response rate 66%. [2] Includes teachers in primary and/or lower secondary schools. [3] Science subjects included biology, physics, chemistry, geography, and environment and nature studies. [4] All respondents were classroom teachers providing primary education. [5] Eight teachers providing both lower and upper secondary education are reported in the number of upper secondary education teachers.

More than 75% of the science teachers had over ten years of teaching experience. However, their experience with integrated practices and collegial collaboration was limited (see Table A1 in Appendix A). The results show that primary school teachers have used all of the integrated practises more than secondary school teachers. Four secondary school teachers, three with over ten years of experience and a novice teacher, reported that they had never implemented any form of integrated practices.

Most teachers (93.5%) had organised integrated activities, such as a theme day, class event or a school visit, at least once a year. The six teachers who had never organised any integrated activities were all from secondary schools. Half of the teachers had never executed more extensive (at least a week in length) integrated study units, while 28.7% reported having done so less than five times during their teaching career. Collaboration within the same subject was more common than interdisciplinary collaboration. However, 11.3% of the teachers stated that they had never collaborated with colleagues.

The sample does not represent the science teacher population because of the channels used for distributing the e-survey. Therefore, the results might overtly present the opinions of teachers who are actively following online forums for science teachers and who are interested in developing their education, thus creating a possible bias in the sample.

3.3. Mixed Methods

The mixed method approach via exploratory factor analysis, data-driven content analysis and descriptive analysis was used in this study to better understand science teachers' perceptions of ISE and of self-efficacy in relation to ISE (see Figure 1).

3.3.1. Exploratory Factor Analysis

EFA was conducted using SPSS (Software Package for Social Science, version 24.0). The survey consisted of 31 five-point Likert scale variables that tested teachers' conceptions of ISE. Three variables with 20% or more missing values were removed from the initial factor analysis, resulting in 28 items and a N:p ratio of 3:1. As this is a small dataset for factor analysis, the researchers felt that omitting cases with missing values would cause more bias than using a missing value technique that retained all participants. Therefore, only cases with more than 40% missing values were eliminated to maximise the sample size (n = 89). Further, the factor extraction process to diminish biased results was meticulously

implemented according to the recommendation given by McNeish [52] in his study on the combined effect of a small sample and missing values when using EFA, while also ensuring that the extracted factors make conceptual and theoretical sense [53].

Missing values (3.4%) were tested using Little's MCAR test, and they proved to be missing at random (MAR) (Chi-Square = 716.571, DF = 653, Sig. = 0.042). Both predictive mean matching (PMM) and expectation maximisation (EM), the recommended missing value techniques [52,54], were tested with similar results. EM was chosen for its simplicity for making calculations in SPSS. Multicollinearity was checked and did not cause issues when conducting EFA. Likewise, multivariate outliers were checked, with none being found.

The factorability of the 28 variables was examined using several criteria that supported the usefulness of factor analysis for the data and the inclusion of all the items in the analysis. First, the Kaiser–Meyer–Olkin measure of sampling adequacy proved adequate (KMO = 0.672), while Bartlett's test of sphericity was significant ($p < 0.001$). Second, all the diagonals of the anti-image correlation matrix were above 0.5, except for four variables (>0.4). Finally, the initial communalities were all above 0.4. Principal axis factoring (PAF) was used as an extraction method with promax as a rotation method.

Several extraction criteria were employed to determine the best number of factors, including Kaiser's rule (eigenvalue > 1), scree plot and parallel analysis [55] with permutation. Seven variables were omitted during several factor runs because they failed to meet the minimum criteria of having (1) a primary factor loading of 0.4 or above and (2) a cross loading of 0.3 or above. For the resulting 21 variables, a factor structure with four factors was clearest and best described the data according to the researchers.

3.3.2. Content Analysis

The analysis here included science teachers' answers to open-ended questions about how best to define integration and the possibilities and challenges of implementing ISE. The researchers discarded answers and text segments that were irrelevant to the principal focus of this content analysis. The technique employed here utilises frequency counts as well as more interpretive, data-driven thematic analysis that focuses on describing the meaning of communications in specific contexts [56,57]. Using both quantitative and qualitative analysis of texts adds to the quality of the analysis [58].

Content analyses should be systematic and replicable [56,59]. However, qualitative content analyses require greater researcher judgments in coding and in data analysis [56]. With qualitative content analysis, the inter-coder reliability is of particular significance, since content-related arguments should be given preference over procedural arguments and validity should be regarded more highly than reliability [57].

The preliminary coding and category formulation process, based on the four-factor EFA solution, was carried out with a portion of the sample (secondary teachers, approx. 2/3 of the total sample) by two researchers. The similarities and differences were discussed before one of the researchers formulated a coherent category system that was tested via inter-coder reliability. The category system included three parts, one for each question. The coding and review process was repeated by the researcher and each time after a discussion with the coder until a satisfactory kappa result (0.7 or higher) was obtained. For the final category solutions, inter-coder testing was conducted both with an outside coder (Cohen's kappa 0.804) and with the two researchers who had formulated the preliminary categories (Cohen's kappa 0.914).

4. Results

The findings on science teachers' perceptions and self-efficacy in the context of ISE are presented per research focus. First, we present teachers' perceptions of ISE (see Section 4.1). Second, we show results on teachers' self-efficacy (see Section 4.2) that proved to be a key factor in the exploratory factor analysis explaining most (23.04%) of the total variance in teachers' perceptions of ISE. However, as the findings are mainly based on the categories

(content analysis) and factors (exploratory factor analysis), we shortly present these solutions before delving deeper into the results.

The final factor solution included variables with factor loadings over 0.4 and explained 52.5% of the total variance in teachers' perceptions of ISE via the following four factors: (F1) *self-efficacy for ISE*, (F2) *relevance of ISE*, (F3) *challenges of ISE* and (F4) *multifaceted nature of ISE*. Table A2 (see Appendix A) shows the factor loading matrix and communalities for all variables in the final four-factor solution. We examined the internal consistency of each factor using Cronbach's alpha, and the results were moderate: (F1) *the self-efficacy for ISE* factor (7 items) was 0.874, (F2) *the relevance of ISE* factor (5 items) was 0.858, (F3) *the challenges of ISE* factor (4 items) was 0.765 and (F4) *the multifaceted nature of ISE* factor (5 items) was 0.688. No increases in alpha for any of the factors would have been achieved by eliminating more items.

The category system resulting from the content analysis consisted of three parts:

1. Categories of integrated education included eight categories (see Section 4.1.1) with *interdisciplinary*, *wholeness* and *phenomenon-based* being the most frequent concepts teachers used to describe integrated education.
2. The possibilities of ISE included eight categories (see Section 4.1.2). *Integrity of knowledge* and *motivation* were the two categories best describing teachers' perceptions of the possibilities.
3. The challenges of ISE included seven categories (see Section 4.1.3) with *administration* and *time* related challenges being the main barriers for teachers for implementing ISE.

4.1. Teachers' Perceptions of Integrated Science Education

Teachers' perceptions of ISE and the possibilities and challenges of implementing ISE are described in three sections named according to the corresponding factor: 4.1.1 Multifaceted nature of ISE, 4.1.2 Relevance of ISE and 4.1.3 Challenges of ISE.

4.1.1. Multifaceted Nature of ISE

Factor F4, *the multifaceted nature of ISE*, consisted of five items, which explained 5.06% of the total variance with factor loadings ranging from 0.45 to 0.68 (see Table A2 in Appendix A). One variable (in integrated education, one must apply the skills and knowledge learned within the context of everyday life), with a primary loading 0.55, had a cross-loading of 0.30 for the challenge factor. However, the researchers felt the variable fits into the context of the factor and the solution was stronger with this variable than without it.

Content analysis of the way science teachers choose to define integrated education further elucidated the diverse nature of ISE (see Table 2). The variable stating integrated education as student-centred approach characterised factor F4 the most; in contrast, this characterisation did not appear equally in teachers' definitions of integrated education in the content analysis. For the most part, teachers' definitions emphasised (1) collaboration between subjects, which we categorised either as *multidisciplinary* or *interdisciplinary*, and (2) the importance of examining the complexity of issues as comprehensive whole (*wholeness*) and using a *phenomenon-based approach*. Some teachers presented contradictory views as to whether such integration should take the form of subject-based or phenomenon-based integration.

Teachers' experiences with integrated activities affected their perception of ISE. Teachers who reported regularly engaging in integrated activities (at least five times a year) agreed more with statements about the multifaceted nature of ISE ($p = 0.031$, Fisher's Exact Test). Furthermore, we noted some interesting differences between the views of primary and secondary school science teachers. First, their perception of ISE as being interdisciplinary varies: 30.6% for primary school teachers and 15.7% for secondary school teachers. Second, compared to primary school teachers, the perceptions of secondary school teachers aligned more with subject-based integration (12.9% of secondary school teachers; 2.8% of primary school teachers) and multidisciplinary approaches (11.4% of secondary school teachers; 5.6% of primary school teachers). We investigated these differences using cross

tabulation but did not find enough evidence to suggest a statistically significant association since the p-value was greater than 0.05 ($p = 0.198$, Fisher's Exact Test).

Table 2. Factor F4 (multifaceted nature of integration) variables with corresponding categories of content analysis regarding science teachers' definitions of integrated education (IE). Frequencies (%) are shown based on occurrences ($n = 127$) per category.

Factor F4 Variables (Factor Loading)	Examples of Science Teachers' Definitions of Integrated Education (IE)	Categories of IE	Freq (%)
Student-centred approach is essential in IE (0.68)	'Teaching disciplines through students' lives and their experiences.' (Teacher 39) 'Personally meaningful for the students.' (Teacher 59) 'Help and support the students according to their individual needs.' (Teacher 74)	Student-centred	7.1
IE should be linked to students' daily lives and to society (0.57) In IE, one must apply the skills and knowledge learned within the context of everyday life (0.55)	'The understanding of the wholeness of issues influencing peoples' living environment.' (Teacher 44) 'Integrated education combines the school world and daily lives together, in which case the learning will be done from the perspective of multiple disciplines, students' daily lives and even working life.' (Teacher 32)	Everyday life	7.1
IE requires collaboration between subjects (0.46)	'Discussing phenomenon-based issues that cross subject boundaries. The aim is to understand the links and dependencies between different contents of learning.' (Teacher 18) 'Integrated education refers to crossing subject boundaries and teaching doesn't necessarily happen in school.' (Teacher 32)	Interdisciplinary	21.3
	'Learning about health education, home economics, biology and environmental issues in chemistry. Traffic, physical education, etc., together with physics. Math can be applied within all in appropriate places.' (Teacher 82) 'In practice, this means that in mathematics teaching, one can use examples from other subjects and in other subjects use mathematics.' (Teacher 97) 'Learning about a common topic in both subjects, discarding overlapping matter.' (Teacher 2)	Multidisciplinary	7.9
In IE, it is essential to examine the complexity of a phenomenon comprehensively (0.45)	'Teaching forms a logical whole, in which facts link to each other either within traditional subjects or between them. The learning content forms an integrated [whole].' (Teacher 90) 'Students form an integral understanding of concepts and contents.' (Teacher 52)	Wholeness	21.3
	'An interesting issue defines the direction of teaching and the skills to be learned.' (Teacher 54) 'Phenomenon-based education, where matters of several subjects are learned at the same time.' (Teacher 85)	Phenomenon-based	16.5
	'A student can link knowledge and skills across disciplines and within discipline. . . . Math, physics and chemistry are a difficult combination, as people begin to have their thumbs in their palms. You need to know the basics of the subjects and then you can start to innovate...' (Teacher 31) 'It is rehearsal of previously learned [subject matter], adding, deepening and applying it.' (Teacher 100)	Subject-based	10.2
		Other	4.7
		Total	100

In conclusion, teachers in the study defined the *multifaceted nature of ISE* mostly as a student-centred approach that requires collaboration and links different subjects with students' daily lives by focusing on a specific phenomenon or the broader context of daily life and applying skills and knowledge learned in school in such a context. Furthermore, a clear positive correlation (0.44) existed between this factor and the *relevance of ISE* factor.

4.1.2. Relevance of ISE

Factor 2, *the relevance of ISE*, explained 16.43% of the total variance and included five variables underlining different dimensions of relevance, with factor loadings ranging from 0.61 to 0.86 (see Table A2 in Appendix A). Based on the factor variables, the science teachers reported that ISE is *personally relevant* (I would like to use more integrated approaches in my teaching, 0.86), *vocationally relevant* (I think integrated education is a suitable method to teach the subjects I am teaching, 0.69) and *socially relevant* (integrated education helps students to understand the interconnected nature of issues better than traditional education, 0.68).

Science teachers' perceptions of the possibilities of ISE offer some explanation as to why they view ISE as being relevant (see Table 3). The *learning outcomes* category is linked to all other categories, as learning is the general aim of all teaching. This was most evident with the category *integrity of knowledge*, which includes the ability to transfer knowledge and further illustrates how teachers perceive ISE as especially vocationally relevant.

Table 3. Factor F2 (relevance) variables with corresponding categories of content analysis regarding science teachers' perceptions of the possibilities of integrated science education (POSS). Frequencies (%) are shown based on occurrences (n = 100) per category. The abbreviation IE is used for integrated education in the table.

Factor F2 Variable (Factor Loading)	Examples of Science Teachers' Perceptions of POSS	Categories of POSS	Freq. (%)
I would like to use more integrated approaches in my teaching (0.86)	'All the pupils like this method of working. It is also inspiring for myself.' (Teacher 53) 'Motivation increases when one can apply what one has learned in new situations.' (Teacher 100).	Motivation	22.0
I think it is important to implement integration within my own teaching (0.82) I think IE is a suitable method to teach the subjects that I am teaching (0.69)	'The meaningfulness of learning increases.' (Teacher 19) 'Students can get a better understanding of the fact that chemistry is part of everyday life.' (Techer 98) '[Students] can apply things to their daily lives and studies.' (Teacher 5)	Meaningful	13.0
	'It adds a new perspective to one's teaching and one is also learning him/herself.' (Teacher 8) 'Special emphasis is on data acquisition and presentation. The use of ICT is easily incorporated into work.' (Teacher 88)	Variety	8.0
	'Increases well-being at school.' (Teacher 26) 'Students' personal growth in becoming independent.' (teacher 89) 'Joy of learning.' (Teacher 34)	Well-being	8.0
	'Only the sky is the limit . . . student-centred and inquiry-based learning can be better executed, room for students' interests and creativity.' (Teacher 81) 'Students learn from each other, which is a very good thing!' (Teacher 7)	Student-centred	4.0
IE helps students to understand the interconnected nature of issues better than traditional education (0.68)	'The overlapping content of different subjects can be utilised better. The fact that one has learned something in chemistry does not mean one could not study it again in physics. When students realise that they have already learned this in a different context, the "overload" decreases.' (Teacher 30) 'Issues and phenomena will form entities, and all will be linked together.' (Teacher 12)	Integrity of knowledge	27.0
With IE, one can achieve better learning outcomes than with traditional education (0.61)	'Team working skills develop for all involved.' (Teacher 38). 'One learns to pursue knowledge, edit tables and draw conclusions. One learns to apply mathematics.' (Teacher 82) 'One can get absorbed in one's topic more thoroughly.' (Teacher 68)	Learning Outcomes	13.0
		Other	5.0
		Total	100

For the most part, teachers described ISE as relevant because of its potential to (1) motivate teachers or students, (2) enable greater integrity or cohesion of learned knowledge, and (3) be meaningful. This was affirmed by teachers' perceptions of the most essential aims of integrated education for their own subject teaching (see Table 4). The three aims emphasised as the most essential for ISE related to the same sources of relevance, namely *integrity of knowledge*, *motivation* and *meaningfulness*.

Table 4. The frequencies of science teachers' views on the essential aims of integrated science education (ISE). Teachers were asked to choose a maximum of three aims. Frequencies shown per occurrence and per teacher (n = 95).

Aims Associated with ISE	Freq	Freq (% of Occurrences)	Freq (% of Teachers)
Understanding the nature of science and 'how science is done'	19	7.42	20.00
Teaching the subject contents as integrated modules	49	19.14	51.58
Student's growth as an individual	27	10.55	28.42
Learning skills and knowledge needed for everyday life	46	17.97	48.42
Learning skills and knowledge needed from the societal perspective	38	14.84	40.00
Mastery of the subject content (including skills and knowledge)	26	10.16	27.37
To motivate students to study mathematics and science	49	19.14	51.58
Other (specified as collaboration)	2	0.78	2.11
Total	256	100.00	269.47

The 26 teachers who reportedly view mastery of the subject content as an essential aim of ISE were an anomaly among the teachers in the study, as they perceived ISE as being less relevant (p = 0.040, Fisher's Exact Test) and a method not well suited to their teaching objectives (p = 0.031, Fisher's Exact Test). They also reported being less willing to incorporate integration into their teaching (p = 0.034, Fisher's Exact Test). This group of teachers did not differ from the other teachers by school level or by their years of experience in teaching or applying integrated methods.

Furthermore, cross tabulation revealed a statistically significant difference between teachers at different school levels in regard to their views on the relevance of ISE (p = 0.010, Fisher's Exact Test). Secondary school teachers, whether at lower, combined or upper secondary schools, to some extent expressed disagreement with the notion that ISE is relevant, whereas none of the primary school teachers disagreed with it. However, lower secondary school teachers tended to be more closely aligned with primary school teachers, with more than 85% of teachers in both groups with agreeing or strongly agreeing with the relevance statements.

4.1.3. Challenges of ISE

The factor analysis identified *the challenges of ISE* as a latent factor (F3) comprised of four items that explained 7.94% of the variance, with factor loadings ranging from 0.46 to 0.86 (see Table A2 in Appendix A). The variables explaining the challenge factor for the most part emphasise ISE as a time-consuming and laborious method. This factor had a negative correlation with the relevance factor (see Table A3 in Appendix A), indicating that teachers who view integrated approaches as more relevant tend to regard ISE as less of a challenge. The content analysis revealed a wider range of challenges for ISE. The similar range of challenges identified by the teachers, especially those related to time and administration, further highlighted issues related to the factor variables (see Table 5). No teachers provided clarifying statements for the variable '*Implementing integrated education requires cutting subject matter from the lessons*' (0.50), thus we omitted it from the table.

Table 5. Factor F3 (challenges) and F1 (teachers' self-efficacy) variables with corresponding categories of content analysis regarding science teachers' perceptions of the challenges of integrated science education (CHAL). Frequencies (%) are shown based on occurrences (n = 124) per category.

Factor Variable (Factor Loading)	Examples of Science Teachers' Perceptions of CHAL	Categories of CHAL	Freq. (%)
F3: Implementing integrated education is more laborious than traditional education (0.85)	'The laboriousness of planning [integrated lessons].' (Teacher 67) 'Finding suitable topics that offer enough, yet not too much, material. I will have to be the one to find all of the reading tasks, invent topics for art and guide writing essays, etc. . . . ' (Teacher 68) 'Acknowledge all the students adequately.' (Teacher 59)	Implementation	13.7
F3: Integrated lessons require more time from the teacher than carrying out traditional lessons (0.86)	'More time is spent guiding personal project work and [with] assessment. There are also many meetings.' (Teacher 82) 'Planning takes time.' (Teacher 42)	Resource-Time	24.2
F3: Because of a lack of time, implementing integrated education in collaboration with other teachers is difficult (0.46)	'Larger collaboration requires greater personal input outside teaching time, especially at the beginning.' (Teacher 43) 'Scheduling my own teaching with other teachers, teaching groups and issues to be dealt with. Even though there is enthusiasm, good plans are only partly executed because of a lack of time and different schedules.' (Teacher 94)		
	'Courses that could have a lot in common are offered to students in different periods.' (Teacher 30) 'It requires special arrangements from the principal and more resources also for planning.' (Teacher 8)	Administration	25.0
	' . . . one can't execute integration because of the large number of students, and it is impossible to arrange decent sized groups in a manner that allows students into all the courses at the same time. We have even tried to execute an integrated unit with four teachers and four different disciplines, but we did not manage to make the students choose all the required courses at the same time. The current structure should be dismantled for authentic integration to be possible.' (Teacher 64)		
	'Most materials are meant for subject teaching.' (Teacher 43) 'It is difficult to choose the proper materials from all the material out there.' (Teacher 34)	Resource-Other	9.7
	'At the moment, in lower secondary schools people are stuck in their own cubicles teaching their own subjects. Integrated education happens mostly just as talk.' (Teacher 51). 'Students are too conservative and beg for subject boundaries.' (Teacher 12)	Attitude	11.3
	'Small pupils have relatively few skills for working autonomously.' (Teacher 88) 'Basic chemistry must be mastered before teaching can be integrated with other disciplines, such as biology, home economics or physics.' (Teacher 92)	Competence	6.5
F1: Teachers' self-efficacy for ISE	'[All teachers must have . . .] also internalized the method on some level'. (Teacher 38) 'Teacher's knowledge and skills must be sufficiently broad in order to make teaching truly integrated instead of just binding a single lesson to part of a whole unit.' (Teacher 43)		
		Other	7.3
		Total	100

Science teachers did have more to say about two time-related issues. The first issue has to do with always feeling rushed while teaching and not having enough time to teach everything. This includes a notion represented by the factor variable that ISE requires more time from teachers in the classroom. The second time-related issue is that of collaboration, a challenge factor that can partly be seen as an administrative issue.

Administrative challenges are viewed as external by teachers, thus successfully managing them is rarely in the hands of the teachers alone (e.g., curricula and schedule-related issues). In some cases, administrative challenges reportedly emerge because teachers view ISE as something forced on them in a top-down process:

> *'The greatest challenge is the pressure coming from superiors, who dictate that we need to plan integrated study units with a different group each year (the old and already functioning plans cannot be used). These [study units] need to last a certain amount of time, and all subjects must be incorporated within them, even if they do not bring any practical benefits. However, nothing can be taken out of the old syllabus, nor can the hours spent on planning be taken away from somewhere else. Thus, I as a teacher will have to do more work and compress the actual content into a smaller time frame.'* (Teacher 97)

The competence category as a challenge included statements relating either to teachers' professional competence or to students' abilities and skills. The former statements are linked to factor 1) self-efficacy for ISE. In addition, we discovered a negative correlation (−0.35) between self-efficacy and challenge factors (see Table A3 in Appendix A), suggesting that teachers with lower self-efficacy for ISE perceive integration as somewhat more challenging.

4.2. Teachers' Self-Efficacy

Teachers' self-efficacy for ISE was emphasised as a key factor explaining most (23.04%) of the total variance in teachers' perceptions of ISE. It consisted of seven items with factor loadings ranging from −0.60 to −0.86 (see Table A2 in Appendix A). All items referred to high self-efficacy statements, such as '*I possess a sufficient amount of knowledge to implement integrated education*' (−0.86), and were negatively loaded, thus indicating that the latent factor is actually opposite: low self-efficacy. On average, teachers neither agreed nor disagreed with the factor statements (mean 3.20), however their answers varied greatly from '*I strongly disagree*' to '*I strongly agree*'.

In addition, few self-efficacy related challenges emerged from the content analysis, indicating that teachers tend to regard the implementing of ISE as possible only with a certain set of skills, knowledge and professional competence:

> *'[All teachers must have . . .] also internalised the method on some level.'*(Teacher 38)

> *'Teachers' knowledge and skills must be sufficiently broad in order to make teaching truly integrated instead of just binding a single lesson to part of a whole unit.'* (Teacher 43)

Cross tabulation revealed statistically significant differences (p = 0.028, Fisher's Exact Test) between primary and secondary school teachers with regard to their self-efficacy. Primary school teachers showed more confidence in their own abilities at executing ISE lessons and their understanding of integration (46.5% agreed or strongly agreed with the factor statements and only 10.7% disagreed). Secondary school teachers demonstrated more variance in their answers and especially upper secondary teachers expressed less confidence in their competence and more need for support, with 28.6% disagreeing or strongly disagreeing with the factor statements.

Furthermore, teachers who reportedly engage in integrated activities seldom or never expressed lower self-efficacy beliefs (p = 0.001, Fisher's Exact Test) and perceived ISE as more challenging (p = 0.039, Fisher's Exact Test). Teachers with less experience in interdisciplinary collaboration agreed more strongly with statements on the challenges of ISE (p = 0.025, Fisher's Exact Test) and tended to have lower self-efficacy beliefs (p = 0.053, Fisher's Exact Test). The latter difference, however interesting, is not statistically significant.

5. Discussion and Conclusions

In this study, the focus was twofold: (1) to understand how teachers perceive ISE and (2) to assess if science teachers' perceptions of and experiences with integrated education influence their views on self-efficacy in relation to ISE. We used EFA as a starting point to reveal latent factors explaining teachers' perceptions of ISE, and further elaborated on these factors via the content analysis and by comparing them to the experiences teachers reportedly have had with ISE (see Figure 1). Self-efficacy emerged as a key factor explaining teachers' perceptions of and their lack of confidence in implementing ISE as well as their need for support.

The majority of the science teachers in the study had a general understanding of integrated education, though their definitions of it varied. The variance was expected, as there is no consensus on a single definition even among researchers [22]. For the most part, the teachers' definitions emphasised (1) collaboration between subjects, which we categorised either as multidisciplinary or as interdisciplinary, and (2) the importance of examining the complexity of issues as a comprehensive whole and via a phenomenon-based approach. The latter may partly be explained by the approach of the Finnish National Core Curriculum [15] to integrated education. Teachers emphasised the former—collaboration—as vital for the implementation of ISE and felt that it constitutes a time- and administration-related challenge, a finding corroborated by earlier research [5].

The challenges that teachers associated with ISE, e.g., time constraints, administrative issues and laborious implementation, are well in line with earlier findings [5,7,19]. Interestingly, the issue of implementation constraints did not only come up in the question about the challenges of ISE, they emerged as a separate factor and were present in answers on the benefits of and proper way to define ISE. The plethora of challenges reported by teachers can partly be explained by the fact that ISE is still a novelty for Finnish science teachers, a conclusion supported by the number of "I don't know" responses and insecurity showed by teachers when defining integration. Furthermore, it may indicate teachers' frustration with how the educational reform is being executed and with the top-down mandate (see [13]) to use integrated approaches, as Finnish teachers are accustomed to being pedagogically autonomous.

Despite the challenges, these results also indicate that the majority of the science teachers perceive ISE as being relevant for their subject teaching and are willing to implement it more often. Teachers' perceptions of the relevance of ISE are aligned with the three dimensions (personal, vocational, societal) suggested by Stuckey et al. [60], although the issue of personal relevance was mentioned for both students and teachers themselves. Teachers emphasised three sources of relevance above all others: integrity of knowledge, motivation and meaningfulness of ISE. This perception of ISE as relevant should influence how it is implemented in classrooms [5,27,47]. This finding is corroborated by the evidence from the 26 teachers who, contrary to the other teachers in the study, mentioned mastery of the subject content as an essential aim of ISE. They stated that integration is less relevant and less useful for science education and expressed less of an eagerness to adopt integrated approaches in their teaching. However, even the majority of teachers who perceived ISE as relevant noted that they only implement it on rare occasions and in an irregular manner, with few exceptions. There are at least two possible explanations for this contradiction between willingness to implement ISE and actual practice. First, the perceived obstacles can affect teachers' willingness to implement it, especially if the teacher has lower self-efficacy in relation to ISE [5,49]. Second, conflicting educational beliefs and epistemological beliefs may constrain teachers from implementing even positively valued practices [29,48,61].

The results indicate that especially teachers' experiences with integrated activities and interdisciplinary collaboration correlate with their views of ISE and their challenges and self-efficacy beliefs in relation to ISE. This was evident when studying the perceptions of primary and secondary school teachers. Primary school teachers displayed higher self-efficacy for ISE and a more cohesive understanding of integration, and they had more experience with integrated practices and collaboration than did secondary school teachers.

This difference may be explained by differences in the ways of organising education and the curriculum [5,7], as teachers at all levels quite often reported that they must deal with administration-related challenges. Contradictory findings exist, which indicate that secondary school teachers may have higher self-efficacy for science education [62]. However, as self-efficacy beliefs are context related [30], it follows that teachers' self-efficacy for science education and for ISE are separate beliefs.

In conclusion, science teachers reported having little experience with integrated practices and collegial collaboration. It cannot be deduced from these results whether it is a lack of experience that affects teachers' challenge-centred perceptions and their lack of self-efficacy for ISE, or vice versa. Bandura [30] observed that mastery experiences serve as a primary source of self-efficacy, while at the same time there is evidence that teachers with lower self-efficacy are less prone to try new practices [63].

These results cannot be generalised and might overtly present the opinions of teachers who are actively following online science teacher forums. Nevertheless, we feel that the findings are valuable as they (1) paint a picture of teachers' perceptions and self-efficacy beliefs on the eve of a curriculum change that emphasises integrated approaches and (2) add to our understanding of self-efficacy in the context of ISE.

6. Implications

Similar reforms to those made in Finland are being made or have been made in many countries. Implementing ISE is a novelty to Finnish teachers and presents them with multiple barriers to overcome. These findings highlight self-efficacy as a key factor explaining science teachers' perceptions of and their lack of confidence in implementing ISE in such a situation, as well as their need for support. Furthermore, teachers' prior experiences with integrated approaches correlated with their views on ISE and self-efficacy in relation to ISE.

Assisting teachers with successful implementation and offering training opportunities to carry out integrated activities and interdisciplinary collaboration can positively affect teachers' perceptions and self-efficacy in relation to ISE. This can influence teachers' willingness to engage and implement ISE in future [5]. Teachers need feasible models to integrate ISE with classroom practices that focus on integrated activities and collaboration, while at the same time being relevant for subject teaching. Recent efforts towards this have been made; for example, Gardner and Tillotson [64] explored this with a focus on the collective use of space and time as major component of an integrated STEM model. Another example of a pedagogical model is Learn STEM [65] which has been designed in collaboration with researchers and secondary schools in six European countries. Nevertheless, there is still a lot of uncertainty around the implementation possibilities of STEM [17].

Teachers' beliefs are conceived as immutable, incontrovertible and persistent over time [26,29], and the influence of these beliefs can be traced back to when teachers were students themselves [66]. Therefore, ISE reform may be integrated with classroom practices more sufficiently if ISE is taken into consideration already during pre-service teacher training. Some efforts towards this have been made; for example, in their case study, Kousa et al. [67] found out that an interdisciplinary school–industry collaboration course can be an effective way to implement STSE issues into pre-service teaching and significantly raise pre-service teachers' confidence and readiness to teach STSE issues.

Additionally, a collaborative primary–secondary school teacher training programme could be an opportunity to support teachers in future ISE teaching since primary school teachers seem to have higher self-efficacy and more experience with integrative approaches and secondary school teachers have more confidence in teaching science as a subject. However, more research is needed to clarify the feasible models for introducing ISE into pre-service and in-service teacher training and the impact of different teacher training programmes on teachers' beliefs about ISE.

Integrated education remains a desired teaching practice, and teachers need to have a strong sense of their own capabilities in order to overcome the identified challenges. These

findings indicate that on the eve of a curriculum change emphasising integration, Finnish science teachers expressed a varied understanding of ISE and their self-efficacy was as a key factor explaining their lack of confidence in implementing ISE, as well as their need for support. Therefore, policymakers and teacher trainers advocating ISE must not ignore teachers' perceptions and self-efficacy beliefs or else integration will remain insufficiently implemented in science education.

Author Contributions: Conceptualization, O.H. and J.T.; methodology, O.H., J.T. and M.A.; formal analysis and validation, O.H. and J.T.; writing—original draft preparation, O.H.; writing—review and editing, O.H. and M.A.; supervision, M.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research has been carried out with the support of the Finnish Cultural Foundation under Grant 00190277. Open access funding provided by University of Helsinki.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful to Jaana Herranen for her insightful comment and proofreading.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript or in the decision to publish the results.

Appendix A

Table A1. Science teachers' experience with teaching, integrated practices and collaborating with colleagues.

Science Teachers' Teaching Experience							
	Over 10 years	6–10 years	3–5 years	1–2 years	Less than a year	Total	
Teaching experience	72	11	9	2	1	95	
Teaching experience (%)	75.8	11.6	9.5	2.1	1.0	100.0	
Science Teachers' Experience in Integrated Education							
	Never	1–2 times per year	3–5 times per year	Over 5 times per year	1–2 times per month	Over 2 times per month	Total
Integrated practices							
Parallel subjects	19	37	9	10	8	10	93
Periodic subjects	16	16	17	17	5	18	89
Integrated activities	6	43	22	15	3	4	93
Total	41	96	48	42	16	32	275
Total (%)	14.9	34.9	17.5	15.3	5.8	11.6	100.0
Collaboration with Colleagues							
Within the subject	16	25	19	13	6	14	93
Interdisciplinary	26	38	14	8	3	3	92
Total	42	63	33	21	9	17	185
Total (%)	22.7	34.0	17.8	11.4	4.9	9.2	100.0

Table A2. Factor loadings and extracted communalities of exploratory factor analysis regarding science teachers' perceptions of integrated education (IE). All loadings < 0.2 were omitted.

Variables	Factor				Communalities
	1	2	3	4	
1. Factor: Self-efficacy					
I possess a sufficient amount of knowledge to implement IE.	−0.86				0.71
I don't need any support for implementing IE.	−0.82			−0.20	0.64
I can plan and execute integrative learning modules.	−0.77				0.66
I have adequate skills to implement IE.	−0.72			−0.27	0.60
I don't need more integrative teaching material for implementing IE.	−0.66				0.40
Taking integrative instructions into account in my own teaching is easy for me.	−0.62	0.29			0.60
I know enough about other subjects to implement IE.	−0.60	−0.22			0.44
2. Factor: Relevance					
I would like to use more integrated approaches in my teaching.	0.23	0.86			0.65
I think it is important to implement integration within my own teaching.		0.82			0.73
I think IE is a suitable method to teach the subjects that I am teaching.	−0.25	0.69			0.59
IE helps students to understand the interconnected nature of issues better than traditional education.		0.68			0.57
With IE, one can achieve better learning outcomes than with traditional education.		0.61	−0.25		0.60
3. Factor: Challenges					
Integrated lessons require more time from the teacher than carrying out traditional lessons.			0.86		0.66
Implementing integrated education is more laborious than traditional education.			0.85		0.66
Implementing integrated education requires cutting down on subject content.			0.50		0.40
Because of a lack of time, implementing integrated education in collaboration with other teachers is difficult.			0.46		0.33
4. Factor: Multifaceted nature of integration					
A student-centred approach is essential in IE.				0.68	0.42
IE should be linked to students' daily lives and to society.				0.57	0.36
In IE, one must apply the skills and knowledge learned within the context of everyday life.			0.30	0.55	0.44
IE requires collaboration between subjects.				0.46	0.25
In IE, it is essential to examine the complexity of a phenomenon comprehensively.				0.45	0.29
Total variance explained by the factors (squared loadings. %)					52.46
1. Factor: Self-efficacy					23.04
2. Factor: Relevance (of IE)					16.43
3. Factor: Challenges (of IE)					7.94
4. Factor: Multifaceted Integration					5.06

Extraction Method: Principal Axis Factoring with a fixed number of factors.
Rotation Method: Promax with Kaiser Normalisation. Rotation converged in 5 iterations.

Table A3. Descriptive statistics for the four factors relating to science teachers' conceptions of integrated education (n = 89) and the factor correlation matrix (the negative factor loadings of F1 have been taken into account in the factor correlations).

	N of Items	Mean	SD	Variance	Skewness	Kurtosis	Cronbach's Alpha	Factor Correlation Matrix			
								F1	F2	F3	F4
F1. Self-efficacy	7	3.20	0.84	0.71	0.07	−0.45	0.874	1.00			
F2. Relevance	5	3.92	0.81	0.66	−1.00	0.77	0.858	0.12	1.00		
F3. Challenges	4	3.69	0.82	0.67	−0.63	0.30	0.765	−0.35	−0.32	1.00	
F4. Multifaceted Integration	5	4.17	0.58	0.33	−0.58	−0.42	0.688	0.11	0.44	−0.13	1.00

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalisation.

References

1. Dunlop, L.; Turkenburg-van Diepen, M.; Knox, K.J.; Bennett, J. Open-ended investigations in high school science: Teacher learning intentions, approaches and perspectives. *Int. J. Sci. Educ.* **2020**, *42*, 1715–1738. [CrossRef]
2. Leuchter, M.; Saalbach, H.; Studhalter, U.; Tettenborn, A. Teaching for conceptual change in preschool science: Relations among teachers' professional beliefs, knowledge, and instructional practice. *Int. J. Sci. Educ.* **2020**, *42*, 1941–1967. [CrossRef]
3. Lumpe, A.T.; Haney, J.J.; Czerniak, C.M. Assessing teachers' beliefs about their science teaching context. *J. Res. Sci. Teach.* **2000**, *37*, 275–292. [CrossRef]
4. Mansour, N. Science teachers' beliefs and practices: Issues, implications and research agenda. *Int. J. Environ. Sci. Educ.* **2009**, *4*, 25–48.
5. Margot, K.C.; Kettler, T. Teachers' perception of STEM integration and education: A systematic literature review. *Int. J. Stem Educ.* **2019**, *6*, 1–16. [CrossRef]
6. Yilmaz-Tuzun, O.; Topcu, M.S. Relationships among Preservice Science Teachers' Epistemological Beliefs, Epistemological World Views, and Self-efficacy Beliefs. *Int. J. Sci. Educ.* **2008**, *30*, 65–85. [CrossRef]
7. Czerniak, C.M.; Johnson, C.C. Interdisciplinary Science Teaching. In *Handbook of research on Science Education*; Abell, S.K., Lederman, N.G., Eds.; Routledge: New York, NY, USA, 2014; pp. 395–411.
8. Beane, J.A. *Curriculum Integration: Designing the Core of Democratic Education*; Teachers College Press: New York, NY, USA, 1997.
9. Bennett, J.; Lubben, F.; Hogarth, S. Bringing science to life: A synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. *Sci. Educ.* **2007**, *91*, 347–370. [CrossRef]
10. Brante, G.; Brunosson, A. To double a recipe—Interdisciplinary teaching and learning of mathematical content knowledge in a home economics setting. *Educ. Inq.* **2014**, *5*, 23925. [CrossRef]
11. Guerrero, G.R.; Reiss, M.J. Science outside the classroom: Exploring opportunities from interdisciplinarity and research—Practice partnerships. *Int. J. Sci. Educ.* **2020**, *42*, 1522–1543. [CrossRef]
12. Lin, H.; Hong, Z.; Chen, C.; Chou, C. The Effect of Integrating Aesthetic Understanding in Reflective Inquiry Activities. *Int. J. Sci. Educ.* **2011**, *33*, 1199–1217. [CrossRef]
13. Wei, B. In Search of Meaningful Integration: The experiences of developing integrated science curricula in junior secondary schools in China. *Int. J. Sci. Educ.* **2009**, *31*, 259–277. [CrossRef]
14. Li, Y.; Wang, K.; Xiao, Y.; Froyd, J.E. Research and trends in STEM education: A systematic review of journal publications. *Int. J. Stem Educ.* **2020**, *7*, 11. [CrossRef]
15. Opetushallitus. *Finnish National Core Curriculum for Basic Education 2014, Perusopetuksen Opetussuunnitelman Perusteet 2014*; Finnish National Agency for Education [EDUFI]: Helsinki, Finland, 2016. (In Finnish)
16. National Research Council [NRC]. *Next Generation Science Standards: For States, By States*; The National Academies Press: Washington, DC, USA, 2013.
17. Lyons, T. Seeing through the acronym to the nature of STEM. *Curric. Perspect.* **2020**, *40*, 225–231. [CrossRef]
18. Herro, D.; Quigley, C.; Cian, H. The Challenges of STEAM Instruction: Lessons from the Field. *Action Teach. Educ.* **2019**, *41*, 172–190. [CrossRef]
19. Samson, G. From Writing to Doing: The Challenges of Implementing Integration (and Interdisciplinarity) in the Teaching of Mathematics, Sciences, and Technology. *Can. J. Sci. Math. Technol. Educ.* **2014**, *14*, 346–358. [CrossRef]
20. Applebee, A.N.; Adler, M.; Flihan, S. Interdisciplinary Curricula in Middle and High School Classrooms: Case Studies of Approaches to Curriculum and Instruction. *Am. Educ. Res. J.* **2007**, *44*, 1002–1039. [CrossRef]
21. Klein, J.T. A Platform for a Shared Discourse of Interdisciplinary Education. *J. Soc. Sci. Educ.* **2006**, *5*, 10–18.
22. Typologies of Interdisciplinarity: The Boundary Work of Definition. In *the Oxford Handbook of Interdisciplinarity*; Frodeman, R.; Klein, J.T.; Pacheco, R.C. (Eds.) Oxford University Press: Oxford, UK, 2017.
23. Pedretti, E.; Nazir, J. Currents in STSE education: Mapping a complex field, 40 years on. *Sci. Educ.* **2011**, *95*, 601–626. [CrossRef]
24. Stinson, K.; Harkness, S.S.; Meyer, H.; Stallworth, J. Mathematics and Science Integration: Models and Characterizations. *Sch. Sci. Math.* **2009**, *109*, 153–161. [CrossRef]
25. Tschannen-Moran, M.; Hoy, A.W. Teacher efficacy: Capturing an elusive construct. *Teach. Teach. Educ.* **2001**, *17*, 783–805. [CrossRef]
26. Alake-Tuenter, E.; Biemans, H.J.A.; Tobi, H.; Wals, A.E.J.; Oosterheert, I.; Mulder, M. Inquiry-Based Science Education Competencies of Primary School Teachers: A literature study and critical review of the American National Science Education Standards. *Int. J. Sci. Educ.* **2012**, *34*, 2609–2640. [CrossRef]
27. Czerniak, C.M.; Lumpe, A.T. Relationship between teacher beliefs and science education reform. *J. Sci. Teach. Educ.* **1996**, *7*, 247–266. [CrossRef]
28. Jones, M.G.; Leagon, M. Science Teacher Attitudes and Beliefs: Reforming Practice. In *Handbook of Research on Science Education, Volume II*; Lederman, N.G., Abell, S.K., Eds.; Routledge: New York, NY, USA, 2014; pp. 844–861.
29. Pajares, M.F. Teachers' Beliefs and Educational Research: Cleaning up a Messy Construct. *Rev. Educ. Res.* **1992**, *62*, 307–332. [CrossRef]
30. Bandura, A. *Self-Efficacy: The Exercise of Control*; Freeman: New York, NY, USA, 1997.
31. Turkka, J.; Haatainen, O.; Aksela, M. Integrating art into science education: A survey of science teachers' practices. *Int. J. Sci. Educ.* **2017**, *39*, 1403–1419. [CrossRef]

32. Weinberg, A.E.; Sample McMeeking, L.B. Toward Meaningful Interdisciplinary Education: High School Teachers' Views of Mathematics and Science Integration. *Sch. Sci. Math.* **2017**, *117*, 204–213. [CrossRef]
33. Gilbert, J.K.; Bulte, A.M.W.; Pilot, A. Concept Development and Transfer in Context-Based Science Education. *Int. J. Sci. Educ.* **2011**, *33*, 817–837. [CrossRef]
34. Ministry of Education and Culture [MOEC], Finnish National Agency of Education [EDUFI]. *Finnish Education in a Nutshell*; Education in Finland; Grano Oy: Finland, 2018. Available online: https://www.oph.fi/en/statistics-and-publications/publications/finnish-education-nutshell (accessed on 25 May 2021).
35. Dewey, J. *The Child and the Curriculum*; University of Chicago Press: Chicago, IL, USA, 1902.
36. Dewey, J. *The School and Society*; University of Chicago Press: Chicago, IL, USA, 1915.
37. Graff, H.J. *Undisciplining Knowledge: Interdisciplinarity in the Twentieth Century*; Johns Hopkins University Press: Baltimore, MD, USA, 2015.
38. Lobato, J. Alternative Perspectives on the Transfer of Learning: History, Issues, and Challenges for Future Research. *J. Learn. Sci.* **2006**, *15*, 431–449. [CrossRef]
39. Rebello, N.S.; Cui, L.; Bennett, A.G.; Zollman, D.A.; Ozimek, D.J. Transfer of Learning in Problem Solving in the Context of Mathematics and Physics. In *Learning to Solve Complex Scientific Problems*; Jonassen, D.H., Ed.; Routledge: New York, NY, USA, 2007; pp. 223–246.
40. Hurley, M.M. Reviewing integrated science and mathematics: The search for evidence and definitions from new perspectives. *Sch. Sci. Math.* **2001**, *101*, 259–268. [CrossRef]
41. Choi, B.; Pak, A. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clin. Investig. Med.* **2006**, *29*, 351–364.
42. Lederman, N.G.; Niess, M.L. Integrated, interdisciplinary, or thematic instruction? Is this a question or is it questionable semantics? (Editorial). *Sch. Sci. Math.* **1997**, *97*, 57. [CrossRef]
43. Dillon, P. A Pedagogy of connection and education for sustainability. In *Human Perspectives on Sustainable Future*; Rauma, A.-L., Pöllänen, S., Seitamaa-Hakkarainen, P., Eds.; University of Joensuu: Joensuu, Finland, 2006; pp. 261–276.
44. Herro, D.; Quigley, C. Exploring teachers' perceptions of STEAM teaching through professional development: Implications for teacher educators. *Prof. Dev. Educ.* **2017**, *43*, 416–438. [CrossRef]
45. Ring-Whalen, E.; Dare, E.; Roehrig, G.; Titu, P.; Crotty, E. From Conception to Curricula: The Role of Science, Technology, Engineering, and Mathematics in Integrated STEM Units. *Int. J. Educ. Math. Sci. Technol.* **2018**, *6*, 343–362. [CrossRef]
46. Perignat, E.; Katz-Buonincontro, J. STEAM in practice and research: An integrative literature review. *Think. Ski. Creat.* **2019**, *31*, 31–43. [CrossRef]
47. Supovitz, J.A.; Turner, H.M. The effects of professional development on science teaching practices and classroom culture. *J. Res. Sci. Teach.* **2000**, *37*, 963–980. [CrossRef]
48. Gregoire, M. Is It a Challenge or a Threat? A Dual-Process Model of Teachers' Cognition and Appraisal Processes During Conceptual Change. *Educ. Psychol. Rev.* **2003**, *15*, 147–179. [CrossRef]
49. Teig, N.; Scherer, R.; Nilsen, T. I Know I Can, but Do I Have the Time? The Role of Teachers' Self-Efficacy and Perceived Time Constraints in Implementing Cognitive-Activation Strategies in Science. *Front. Psychol.* **2019**, *10*, 1697. [CrossRef]
50. Pelletier, L.G.; Séguin-Lévesque, C.; Legault, L. Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *J. Educ. Psychol.* **2002**, *94*, 186–196. [CrossRef]
51. Woolfolk Hoy, A.; Hoy, W.; Davis, H. Teachers' self efficacy beliefs. In *Handbook of Motivation at School*; Wentzel, K.R., Wigfield, A., Eds.; Routledge: New York, NY, USA, 2009; pp. 627–653.
52. McNeish, D. Exploratory Factor Analysis with Small Samples and Missing Data. *J. Personal. Assess.* **2016**, *99*, 637–652. [CrossRef]
53. Osborne, J.W. *Best Practices in Exploratory Factor Analysis*; CreateSpace: Charleston, SC, USA, 2014.
54. Graham, J.W. Missing Data Analysis: Making It Work in the Real World. *Annu. Rev. Psychol.* **2009**, *60*, 549–576. [CrossRef]
55. O'connor, B.P. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behav. Res. Methods Instrum. Comput.* **2000**, *32*, 396–402. [CrossRef]
56. Drisko, J.W.; Maschi, T. *Content Analysis*; Pocket Guides to Social Work Research Methods; Oxford University Press: New York, NY, USA, 2015.
57. Mayring, P. *Qualitative Content Analysis: Theoretical Foundation, Basic Procedures and Software Solution*; GESIS Leibniz Institute for the Social Sciences: Klagenfurt, Austria, 2014.
58. Cohen, L.; Manion, L.; Morrison, K. *Research Methods in Education*; Taylor & Francis: London, UK, 2007.
59. Krippendorff, K. *Content Analysis: An Introduction to Its Methodology*; Sage: Thousand Oaks, CA, USA, 2004.
60. Stuckey, M.; Hofstein, A.; Mamlok-Naaman, R.; Eilks, I. The meaning of 'relevance' in science education and its implications for the science curriculum. *Stud. Sci. Educ.* **2013**, *49*, 1–34. [CrossRef]
61. Tsai, C. Nested epistemologies: Science teachers' beliefs of teaching, learning and science. *Int. J. Sci. Educ.* **2002**, *24*, 771–783. [CrossRef]
62. Martin, M.O.; Mullis, I.V.S.; Foy, P.; Stanco, G.M. *TIMSS 2011 International Results in Science*; TIMMS & PIRLS, International Study Center, Boston College: Chestnut Hill, MA, USA, 2012.
63. Mckim, A.J.; Sorensen, T.J.; Velez, J.J.; Henderson, T.M. Analyzing the Relationship between Four Teacher Competence Areas and Commitment to Teaching. *J. Agric. Educ.* **2017**, *58*, 1–14. [CrossRef]

64. Gardner, M.A.; Tillotson, J.W. Explorations of an integrated STEM middle school classroom: Understanding spatial and temporal possibilities for collective teaching. *Int. J. Sci. Educ.* **2020**, *42*, 1895–1914. [CrossRef]
65. Stracke, C.M.; Dijk, G.; Daneniene, J.; Kelmelyte, V.; Lisdat, F.; Wesolowski, A.; Barreiros, A.; Baltazar, R.; Simoens, W.; Desutter, J.; et al. *Learn STEM: The Pedagogical Model for Innovative STEM Learning and Teaching*; Open Universiteit: Heerlen, The Netherlands, 2019.
66. McKinnon, M.; Lamberts, R. Influencing Science Teaching Self-Efficacy Beliefs of Primary School Teachers: A longitudinal case study. *Int. J. Sci. Educ. Part B* **2014**, *4*, 172–194. [CrossRef]
67. Kousa, P.; Aksela, M.; Ferk Savec, V. Pre-service teachers'beliefs about the benefits and challenges of STSE based school-industry collaboration and practices in science education. *J. Balt. Sci. Educ.* **2018**, *17*, 1034–1045. [CrossRef]

education sciences

MDPI

Article

Teachers' Expectations and Perceptions of the Relevance of Professional Development MOOCs

Jaana Kristiina Herranen [1,*], Maija Katariina Aksela [1], Maya Kaul [2] and Saara Lehto [3]

[1] Department of Chemistry, University of Helsinki, 00100 Helsinki, Finland; maija.aksela@helsinki.fi
[2] Division of Education Policy, University of Pennsylvania Graduate School of Education, Philadelphia, PA 19104, USA; mayakaul@upenn.edu
[3] Department of Mathematics and Statistics, University of Helsinki, 00100 Helsinki, Finland; saara.lehto@helsinki.fi
* Correspondence: jaana.herranen@helsinki.fi

Abstract: Online professional-development courses such as massive open online courses (MOOCs) could bring relevant content to a wider base of teachers who might not otherwise have access to professional development. However, research on the relevance of such online courses is scarce. The main aim of this study is to investigate the relevance (individual, societal, and vocational) of MOOCs (mostly participatory cMOOCs) from the viewpoint of teachers now and in the future. We examined teachers' expectations and perceptions of 10 courses before (N = 364) and after (N = 177) the courses, using an online questionnaire developed on the basis of relevance theory. According to the results, the studied teachers had positive expectations for the courses in terms of their usefulness for their prospective teaching (especially vocational relevance). Teachers' expectations related to the usefulness of the course for the future (individual and vocational relevance) were most strongly met. Effort put into the course was connected to, for example, how the course improved the teachers' interest. The results of this study indicate that MOOCs can serve as relevant courses for teachers' professional development in science, mathematics, and technology education.

Keywords: relevance; online education; MOOC; teachers; professional development; mathematics education; science education

Citation: Herranen, J.K.; Aksela, M.K.; Kaul, M.; Lehto, S. Teachers' Expectations and Perceptions of the Relevance of Professional Development MOOCs. *Educ. Sci.* **2021**, *11*, 240. https://doi.org/10.3390/educsci11050240

Academic Editor: Neil Gordon

Received: 9 April 2021
Accepted: 13 May 2021
Published: 17 May 2021

1. Introduction

Teachers' ongoing learning is important in promoting their up-to-date knowledge and skills in their field [1–3]. However, teachers' participation in professional-development courses is often challenging, as the courses are usually only organized in some locations, often far away from universities. As a solution, previous research suggested including online courses into teachers' professional programs [4]. This was also studied in the specific context of mathematics and science education [5,6], but more research is needed to understand the degree to which these courses are relevant to teachers. Teachers prefer to have digital tools and optionality used in their training [7]. Massive online open courses (MOOCs) could be a good option to achieve this. However, accessibility alone is insufficient for a successful online course [8]. To be able to offer MOOCs for teachers that they also find relevant for their teaching, more research is needed on the topic.

In science education research, what makes learning relevant for students has been investigated [9]. From a professional-development point of view, it is also highly important to ask what makes learning relevant for teachers. This study, therefore, focuses on the idea of relevance from teachers' point of view. Relevance theory originates from the studies of students' relevance [9]. This study suggests that relevance theory could also be applicable when teachers are studied because related concepts such as interest were also used when learners [10] and teachers [11] were studied.

Mathematics, science, and technology teacher education in Finland operates through multiple platforms [3], and was more recently expanded to online settings [12,13]. In order to support teachers' professional development (PD), online PD courses (or MOOCs) are organized to cover different areas on science, mathematics, and technology education (see Section 3 for details).

The aim of this study is to investigate the relevance of the MOOC courses from the teachers' viewpoint, from the perspective of relevance theory [9] (see Section 2 for details). We concentrate on teachers' expectations of the relevance of the MOOCs before the courses and their perceptions of the relevance of the MOOCs after the courses (how the teachers' expectations were met in the courses).

The research questions are:

- What were the teachers' expectations about the relevance of the MOOC courses that they attended?
- What were the teachers' perceptions of the relevance of the MOOC courses?
- Was there a connection between teachers' backgrounds and their perceptions of the relevance of the MOOC courses?

The hypothesis was that the teachers would find the courses vocationally relevant at the time and for their prospective teaching.

2. Background

2.1. Relevance of Teachers' Professional Development

PD programs are essential to educational change [2,14]. The requirements of programs depend on at who the programs are aimed, and how they approach supporting the development of teachers' pedagogical-content knowledge [15]. For example, previous research recommended that primary teachers take courses that support their STEM expertise so that they can integrate disciplines, have an understanding of pedagogical approaches, and be capable of connecting to real-life relevance [16]. It is also important to focus on content that is linked to the teachers' actual teaching, and which promotes active learning, the support for collaboration, models and modeling of effective practice, expert support and feedback, and reflection through sustained opportunities for professional learning [17].

This research utilizes the relevance theory by Stuckey et al. [9], but earlier work from Van Aalsvoort (2004) also quite similarly described the concept of relevance [18]. Relevance was also described as a synonym for motivation and interest [19]. The main dimensions of Stuckey's relevance model are: (i) individual, (ii) societal, and (iii) vocational [9]. Individual relevance consists of aspects such as "satisfying curiosity and interest" and "skills for coping with personal life in future" [9,20]. Societal relevance is defined by aspects related to persons' behavior in the society, responsibly and through their own interests. Vocational relevance consists of orienting towards, qualifying for, and getting a job, contributing to socioeconomic growth. The present–future range refers to skills and actions now (e.g., satisfying interests, finding their own place) and in the future (e.g., acting responsibly, promoting own interests). The intrinsic–extrinsic range presents relevance from the viewpoint of the learners' interests (intrinsic relevance) and from the viewpoint of societal expectations (extrinsic relevance).

The components of relevance were originally formulated on the basis of studies of students' relevance [9]. In this study, we applied that theory to teachers' professional development.

2.2. Professional Development Using MOOCs as Online Learning Platforms

MOOCs are forms of online learning that are designed to be accessible to all [20–22]. Additionally, MOOCs can help address typical barriers that teachers face in seeking professional development, such as the lack of local offerings, which do not conflict with their work schedules, and the lack of relevant PD [7]. A 2019 systematic review of MOOCs found that 87.5% of 46 examined programs were successful in promising both equity and social inclusion [23]. However, there are challenges in ensuring that MOOCs are accessible

to all and not just those who might already have access to such education [24]. In addition, questions related to the effectiveness of the MOOCs were raised, such as whether they offer teachers a possibility for transformative learning [25].

As such, MOOCs have been studied and implemented as a potential lever to help expand access among teachers globally to high-quality PD. Previous PD MOOCs are organized around topics left undercovered in traditional PD, such as topics related to sustainability [5] or social media as a pedagogical tool [26]. These studies provide emerging evidence supporting that MOOCs could be particularly effective as a method for providing teachers with up-to-date content knowledge to which they may otherwise not have access.

Despite the growing use of MOOCs in PDs [27], they have largely not been studied in the context of relevance. Previous studies examined how to design MOOCs and pedagogy, teachers' interest and motivation, and MOOC effectiveness [27]. PD MOOCs were mostly studied from the viewpoint of concepts related to relevance, such as teachers' views [27] and experiences [28]. According to the study by Koukis and Jimoyiannis [27], a successful PD MOOC connects the course and the actual classroom, has concrete learning aims, supports teacher collaboration, and creates a learning community. In Wambugu's study, the participants found the designed MOOC to be interesting, appealing, and flexible, and they learned from each other [28].

How people learn through MOOCs also depends on the participants. In an MOOC course for undergraduate students, goal setting and task interest were the main predictors of their MOOC completion [29]. To support participation and learning, MOOC developers sometimes refer to "cMOOCs" as those that include collaboration and focus on participants building connections with other participants and the lecturer [30]. "xMOOCs", on the other hand, are those that aim to offer high-quality content delivery for the participants and focus less on collaboration among participants [30]. While xMOOC pedagogics have been criticized, they also took a research-based approach to improving their completion rates [31]. A recent case study reported that high-impact online teaching practices included both effective content delivery and the possibility for students to be supported for their learning and participation [32]. In addition, to support communication, synchronous (real-time) communication is used in online learning, as opposed to or together with asynchronous learning [33]. A cMOOC can include both types of communication.

Studies related to relevance of MOOC for teachers show that MOOCs are useful in scaling up PDs and removing participant barriers [7]. In a study by Powell and Bodur [8], the relevancy of their online PD course was defined by its ability to attend to teachers' individual professional learning needs. According to their teacher interviews, teachers saw the lack of personalization as inhibiting the relevance of the course. The more experienced teachers may have different needs for the course than those of less experienced ones.

It is important to study teachers' MOOC expectations and perceptions of relevance because teachers' expectations and perceptions of relevance could be useful in improving PD MOOCs.

3. Context

3.1. National LUMA FINLAND Program and MOOCs

The MOOCs studied in this research were developed as part of the national LUMA FINLAND Program (2014–2019). This was a development program for inservice teacher education funded by the Ministry of Education and Culture of Finland, and implemented via the LUMA Centre Finland network. The aim of the program was to enhance interest in science, mathematics, and technology among 6–16-year-old students by developing and studying new modes of professional development for preparing teachers to engage in the 21st century STEM curriculum. The program consisted of a development phase (2014–2016), during which new research-based teaching methods were developed in cooperation with inservice teachers, and university experts and researchers; and a dissemination phase (2017–2019), during which nationwide inservice teacher education was organized and implemented.

One of the goals of the program was to reach teachers from all around the country, including municipalities farther away from universities and larger cities. Towards this aim, 13 MOOCs were designed as part of the program as a means of disseminating the educational products developed in the program. The program was both focused on producing MOOCs, and developing and offering PD for teachers. However, this study focuses on those MOOCs. The use of MOOCs was new for PD in the LUMA Finland setting. This is why we were interested to study the relevance of those MOOCs. Dissemination was successful, and the program reached approximately 80% of Finland's 311 municipalities. A significant part of the success was driven by the reach of the MOOCs. Several of them are still operational, and material from the MOOCs continues to be offered through videos.

Ten out of 13 courses of the national LUMA Finland program are included in this research (i.e., those that did not have another research focus). Of the 10 MOOCs in this study, 3 concentrated on project learning and nonformal education in science and mathematics, 2 on mathematics education, 3 on programming and game programming, 1 on school–business cooperation in science and mathematics education, and 1 on work–life knowledge in science and mathematics education (see Appendix A). MOOCs were aimed at different teaching levels covering preschool, primary education, and lower secondary education with a slight emphasis on the higher levels.

The MOOCs were mainly cMOOCs (rather than xMOOCs), which means that they offered active participation and collaboration within the courses, and also synchronous communication, in particular during the dissemination phase of the development program. Some of the courses were webinars, so there was less collaboration (see Appendix A).

3.2. Three MOOC Examples

As an example of the format and development process of these MOOCs, we describe three MOOCs with different development program areas: 'Basics of game programming with Unity', 'Everyday Phenomena and Projects in STEAM Education', and 'Towards the Better Understanding of Numbers and Equations'.

Each of these three MOOCs had different aims. They were either quite concrete, as in the 'Basics of game programming with Unity', in which the aim was to familiarize the participants to (game) programming, or more abstract, as in 'Everyday Phenomena and Projects in STEAM Education', in which the aim was to support and inspire teachers to carry out integrated and phenomenon-based science education through project learning. Phenomenon-based learning refers to the pedagogy of viewing learning as a whole, taking into consideration the natural phenomenon of the subject being taught, the students' active learning process, and the teacher and their reflection [34]. 'Towards Better Understanding of Numbers and Equations' had both types of aims. The aim was to open new perspectives for teachers on how to examine mathematical learning and teaching with "new eyes" through developing flexible mathematical and algebraic thinking, and to provide concrete tools to do so.

The courses were applied to teaching in school, as the participants were given examples that they could use in their own teaching. In 'Basics of game programming with Unity', students participated in the course with their own teacher. Curriculum connection was also often emphasized, as in 'Everyday Phenomena and Projects in STEAM Education', where the course material was planned according to the curriculum. The material had practical examples, including, e.g., other teachers' teaching examples, tips for evaluation, examples of everyday phenomena that could be used in phenomenon-based learning, a model for inquiry-based teaching, examples for collaboration, science drama, and the use of ICT. There was also a possibility to plan an integrative-teaching sequence with other participants with the course teacher's support.

Each course had a length of 10–50 h depending on format and aims. Most of the courses allowed for participants to complete the material in their own time and at their own place; therefore, the instructor was not available to support all the time. As an exception, 'Basics of game programming with Unity' was offered within a certain time frame.

The courses included text, pictures, and videos that the participants were provided to perform tasks. Participants were asked to watch videos, read texts, write texts (such as practical work plans and learning diaries), take tests, and participate in discussions. The courses were c-type MOOCs, including interaction with the other participants and the course developers.

Each course was developed through a slightly different process. 'Basics of game programming with Unity' began as a coding camp, followed by a course, and lastly a web version, with several iteration phases. Collaboration among course developers was central to the development process of this course. In 'Towards Better Understanding of Numbers and Equations', three course developer teams first produced their own material and approaches. An algebraic path from preschool to secondary school was created through collaboration among developers. Live training was first carried out, and the MOOC was then developed through peer support, and dividing the tasks on the basis of skills and available time. 'Everyday Phenomena and Projects in STEAM Education' was developed together with teachers, and thereby doubled as a year-long inservice training sequence for the teachers. The final MOOC course was a result of further development through teacher and student feedback, as the course was offered to teachers and students with different formats.

4. Research Method

This is a quantitative-survey study for which an online questionnaire was developed for teachers on the basis of the theory of relevance [9]. The teachers were asked about their perceptions of the relevance of MOOCs individually, societally, and vocationally. For the purpose of applying the theory of relevance for teachers, the dimensions of the model were slightly modified. The developers of the model explained that the different dimensions could be weighted depending on the learners' age, for example [9]. Keeping that in mind, the temporal range is less clear when we talk about teachers because they have already chosen their careers. They can, however, approach professional-development course content from the viewpoint of their current teaching and their prospective teaching. This is because the demands for their prospective teaching might be different than the demands that they have now, as the world is constantly changing. Additionally, external and internal demands can be quite different depending on how old the study participants are. Some of the aspects might overlap, such as the individual dimension with the intrinsic end of the intrinsic–extrinsic range, and the societal dimension with the extrinsic end of the intrinsic–extrinsic range. This confusion led us to construct the teacher questionnaire without the intrinsic–extrinsic range. However, we kept the present–future range. In addition, the temporal component was further strengthened by administering the prequestionnaire (focused on teachers' expectations before the course) and postquestionnaire (focused on teachers' perceptions after the course).

Teachers answered both the pre- and the postquestionnaire. The prequestionnaire was aimed at capturing the teachers' expectations for the course for which they registered (n = 364). The postquestionnaire was aimed at examining how expectations were met in the course (n = 177). Participants were asked to answer the postquestionnaire immediately after completing the course. The validity of the survey was examined by principal-component analysis (PCA) using autumn 2018 data (165 responses in prequestionnaire and 88 responses in postquestionnaire). Items in the questionnaire were loaded onto two components (with Cronbach's alpha values > 0.7) in the pre- and postquestionnaires. The requirement for conducting PCA was also estimated by running Kaiser–Mayer–Olkin measure of sampling adequacy, which was 0.799, and Bartlett's test of sphericity ($p < 0.001$).

The components onto which the questionnaire items were loaded were:

(i) socioindividual relevance: items related to individual and societal relevance; and
(ii) vocational relevance: items related to usefulness in the future/for the vocation.

However, not all items were loaded onto the components; thus, those items were individually handled.

Correlations were counted with SPSS using Spearman's correlations. Correlations were counted with teachers' background items and relevance: both relevance components and individual relevance items in the questionnaire.

5. Participant Backgrounds

The prequestionnaire was answered by 364 MOOC participants, and the postquestionnaire by 177 participants. Of the respondents, 308 (84.62%) in the prequestionnaire were women and 54 (14.84%) were men (two of the respondents did not wish to indicate their gender). Participants' age, teaching experience, and teaching level are shown in Table 1.

Table 1. Age, teaching experience, and teaching level of respondents.

Age (y)	preQ n (%)	postQ n (%)
18–25	37 (10.16%)	18 (10.17%)
26–35	89 (24.45%)	34 (19.21%)
36–45	96 (26.37%)	67 (37.85%)
46–55	93 (25.55%)	43 (24.29%)
56–65	49 (13.46%)	15 (8.47%)
Over 65	0 (0%)	0 (0%)
Teaching experience (y)	**preQ n (%)**	**postQ n (%)**
0–2	70 (19.23%)	29 (16.38%)
2–5	58 (15.93%)	29 (16.38%)
5–10	63 (17.31%)	35 (19.77%)
10–20	86 (23.63%)	49 (27.68%)
Over 20	87 (23.90%)	35 (19.77%)
Teaching level [1]	**preQ n (%)**	**postQ n (%)**
Early-childhood education	15 (4.12%)	15 (8.47%)
Preschool	41 (11.26%)	23 (12.99%)
Primary education, Levels 1–2	85 (23.35%)	45 (25.42%)
Primary education, Levels 3–6	94 (25.82%)	42 (23.73%)
Lower secondary school	159 (43.68%)	75 (42.37%)
Upper secondary school (gymnasium)	70 (19.23%)	31 (17.51%)
Upper secondary school (vocational school)	10 (2.75%)	2 (1.13%)
Higher education	7 (1.92%)	2 (1.13%)
Primary-school student teacher	25 (6.87%)	28 (15.82%)
Secondary-school student teacher	31 (8.52%)	11 (6.21%)
Other [2]	18 (4.95%)	6 (3.39%)

[1] There are some overlapping responses because teachers might teach several grades. [2] Other teaching levels include mainly special-education teachers and adult educators.

6. Results

6.1. Teachers' Expectations for PD Courses

The studied teachers had positive expectations for the PD courses. When asked about their expectations, most of the teachers' responses varied between agree and fully agree (see Table 2). Teachers expected that the course would be especially useful for their prospective teaching (see Items 3, 7, 8, and 9 in Table 1). Teachers, however, had the lowest expectations for the course's influence on their appreciation for mathematics, science, technology, or their teaching (Item 6).

6.2. How Teachers' Expectations Were Met in the PD Courses

After completing the course, teachers considered the courses to be vocationally relevant: almost all teachers reported that they planned to put what they had learned to use, irrespective of the course that they had completed. However, teachers' responses to the postquestionnaire indicated that the courses did not fully meet their original expectations, which were very high. Teachers' expectations to learn about collaboration and significance

were the farthest from being met (see Items 3, 7, and 9 in Table 3). Teachers also had big hopes for the courses related to those aspects, as Table 2 shows.

Table 2. Teachers' expectations of the relevance of MOOCs before the course.

Question	5	4	3	2	1	Mean	SD
Individual relevance							
1. I hope that the course will improve my interest about mathematics, science, technology and their teaching	201 (55.1%)	123 (33.7%)	33 (9.0%)	5 (1.1%)	3 (0.8%)	4.40	0.78
2. I hope that I will learn to understand more about mathematics, science, technology and their teaching	226 (61.9%)	110 (30.1%)	24 (6.6%)	4 (1.1%)	1 (0.3%)	4.53	0.69
3. I hope that I will learn things that are useful for me in the future	305 (83.6%)	52 (14.3%)	3 (0.8%)	2 (0.6%)	3 (0.8%)	4.79	0.56
Societal relevance							
4. I hope that I will learn new things about collaboration with my colleagues and other stakeholders	160 (43.8%)	150 (41.1%)	47 (12.9%)	5 (1.1%)	3 (0.8%)	4.25	0.79
5. I hope that I will get information about the significance of mathematics, science, technology, or their teaching for the society	156 (42.7%)	147 (40.3%)	49 (13.4%)	11 (3.0%)	2 (0.6%)	4.21	0.83
6. I hope that the course will improve my appreciation over mathematics, science, technology or their teaching	143 (39.2%)	128 (35.1%)	78 (21.4%)	12 (3.3%)	4 (1.1%)	4.08	0.91
Vocational relevance							
7. I hope that I will learn in the course useful skills or information for my own teaching	327 (89.6%)	31 (8.5%)	3 (0.8%)	0 (0%)	4 (1.1%)	4.86	0.52
8. I hope that the course will widen my perspectives about mathematics, science, technology or their teaching	267 (73.2%)	79 (21.6%)	15 (4.1%)	0 (0%)	4 (1.1%)	4.66	0.66
9. I hope that the course will affect positively into my prospective teaching	314 (86.0%)	43 (11.8%)	4 (1.1%)	0 (0%)	4 (1.1%)	4.82	0.55

Table 3. Teachers' perceptions of the relevance of MOOC courses.

Question	5	4	3	2	1	Mean	SD
Individual relevance							
1. The course improved my interest about mathematics, science, technology and their teaching	78 (44.1%)	78 (44.1%)	16 (9.0%)	3 (1.7%)	2 (1.1%)	4.28	0.79
2. I learned to understand more about mathematics, science, technology and their teaching	59 (33.3%)	83 (46.9%)	29 (16.4%)	4 (2.3%)	2 (1.1%)	4.09	0.83
3. I learned things that are useful for me in the future	117 (66.1%)	52 (29.4%)	5 (2.8%)	2 (1.1%)	1 (0.6%)	4.59	0.66
Societal relevance							
4. I learned new things about collaboration with my colleagues and other stakeholders	47 (26.6%)	76 (42.9%)	33 (18.6%)	17 (9.6%)	4 (2.3%)	3.82	1.01
5. I got information about the significance of mathematics, science, technology, or their teaching for the society	36 (20.3%)	77 (43.5%)	43 (24.3%)	15 (8.5%)	6 (3.4%)	3.69	1.00
6. The course improved my appreciation over mathematics, science, technology or their teaching	56 (31.6%)	79 (44.6%)	33 (18.6%)	6 (3.4%)	3 (1.7%)	4.01	0.89
Vocational relevance							
7. I learned useful skills or information for my own teaching	120 (67.8%)	48 (27.1%)	6 (3.4%)	2 (1.1%)	1 (0.6%)	4.60	0.67
8. The course widened my perspectives about mathematics, science, technology or their teaching	79 (44.6%)	74 (41.8%)	21 (11.9%)	1 (0.6%)	2 (1.1%)	4.28	0.78
9. The course affected positively into my prospective teaching	116 (65.5%)	52 (29.4%)	7 (4.0%)	1 (0.6%)	1 (0.6%)	4.59	0.65

When we studied the connections between teachers' backgrounds and their perceptions of the relevance of the MOOC courses, we found correlations between relevance and

background items. The studied background items were teachers' teaching experience, age, and effort put into the course.

Relevance (socioindividual relevance F1 and vocational relevance F2) correlated with teaching experience: the more experienced teachers were, the more relevant they thought the MOOC course was (see Table 4). Experience also correlated with Items R1, R2, R3, R6, R8, and R9. Age correlated with interest, understanding, and appreciation: older teachers considered the course to be more relevant in terms of raising their own interest, understanding, and appreciation for mathematics, science, technology, or their teaching (Items R1, R2, and R6). Effort put into the course correlated with interest and the broadening of perspectives (Items R1 and R8).

Table 4. Correlation of relevance items with teachers' background. Exp = experience, age = teachers' age, and eff = effort. R1–R9 are individual relevance items, F1 is societal and individual relevance, and F2 is vocation of relevance. Spearman's correlation coefficient was used with two-tailed significance, n = 177.

		Exp	Age	Eff
		cc. sig.	cc. sig.	cc. sig.
Individual relevance	R1	0.338 ** 0.000	0.325 ** 0.000	0.167 * 0.026
	R2	0.215 ** 0.004	0.203 ** 0.007	0.108 0.153
	R3	0.149 * 0.048	0.048 0.526	0.133 0.78
Social relevance	R4	0.087 0.248	−0.022 0.774	0.086 0.257
	R5	0.079 0.293	0.039 0.603	0.101 0.179
	R6	0.151 * 0.045	0.152 * 0.044	0.047 0.534
Vocational relevance	R7	0.094 0.214	0.022 0.772	0.094 0.215
	R8	0.185 * 0.014	0.085 0.263	0.155 * 0.039
	R9	0.179 * 0.017	0.134 0.076	0.120 0.113
Socioindividual relevance	F1	0.149 * 0.048	0.091 0.226	0.128 0.090
Vocational relevance	F2	0.176 * 0.019	0.079 0.298	0.127 0.091

* Correlation significant at the 0.05 level (2-tailed). ** Correlation significant at the 0.01 level (2-tailed).

7. Discussion and Conclusions

In order to improve mathematics, science, and technology teaching through MOOCs, MOOCs need to be accessible [24]. A successful MOOC is also relevant to teachers, as suggested in this research and before in terms of teachers' professional development in general [16]. The studied teachers had big expectations for the courses in terms of their usefulness for their prospective teaching, and those expectations were close to being met. More precisely, teachers' expectations for collaboration and science, mathematics, and technology teaching were the closest of being met. Collaboration with colleagues was an important component of a successful MOOC [27]. Therefore, a MOOC that is collaborative could be created. Connectivist MOOCs (cMOOCs) are especially concentrated on active participation and connecting with other participants and the teachers [35].

Teachers' effort put into a course was associated with the degree to which they reported that the course improved their interest. The more time one puts into a course, the more interested one could be. However, because correlation was measured and not causality,

interest could also be awakened early on in the course, which makes teachers invest time during the course. Teachers could be encouraged to invest more time in a course by making the courses personally interesting to them (individual relevance).

This study also indicated that teachers' perceived relevance was connected to their experiences. More experienced teachers considered the courses to be more relevant. Therefore, PD MOOCs could be personalized for novice and more experienced teachers. This resonates with earlier findings that teachers find MOOCs to be less relevant when they lack the ability to personalize their learning [8].

The survey revealed aspects related to measuring teachers' relevance: vocational relevance formed its own component. Thus, relevance theory appears to be different in students vs. teachers. For teachers, individual and societal relevance are closely connected, whereas vocational relevance appears to be a separate aspect of relevance. According to the original model [9], vocational relevance (and other aspects of relevance) has a present–future axis. For students, present vocational aspects orient towards the future (passing exams and orienting towards a future career). Teachers, on the other hand, are already living that future by having chosen a teacher career. For them, a course can provide ideas for their future, and through giving ideas and skills that they can use in their prospective teaching. According to this study, the teachers found the courses relevant in that sense. A relevant PD course could be looking at teaching practices now and for the future, according to the idea of lifelong learning. That approach was used in our exemplary courses. Due to differences in students' and teachers' experienced relevance, the relevance instrument could be modified if teachers' relevance instead of that of students is measured. We presented one possible instrument in this paper.

To further develop this instrument, the internal–external range could be taken into account. Teacher's intrinsic expectations affect how they learn, and external expectations (from society and through national curricula) affect teachers' participation in PDs and MOOCs, and the need to develop PDs and MOOCs for teachers. That kind of framework could describe both teachers' external and internal expectations, and society's expectations for, e.g., universities to develop PDs and MOOCs. The internal–external range could be taken into account by including items that concentrate on, e.g., teachers' expectations and perceptions related to external and internal demands. In addition, there are probably other important aspects to still consider, such as teachers' digital competences and orientation towards life-long learning. The effect of the course developers could also be taken into account.

The results of this study indicate that MOOCs could serve as relevant courses for teachers' professional development in science, mathematics, and technology education. Even if this research does not clearly indicate that MOOCs would be more relevant than traditional PD courses are, PD MOOCs provide training to a wider audience, which could make them worth developing and utilizing. The given results encourage continuing the design of relevant cMOOCs for teachers in future research in the topic.

Author Contributions: Conceptualization, M.K.A., M.K. and S.L.; Data curation, J.K.H.; Formal analysis, J.K.H.; Funding acquisition, M.K.A.; Investigation, J.K.H.; Methodology, J.K.H., M.K.A., M.K. and S.L.; Project administration, M.K.A.; Software, J.K.H., M.K. and S.L.; Supervision, M.K.A.; Validation, J.K.H.; Visualization, J.K.H.; Writing—original draft, J.K.H., M.K.A., M.K. and S.L.; Writing—review & editing, J.K.H., M.K.A., M.K. and S.L. All authors have read and agreed to the published version of the manuscript.

Funding: Open access funding provided by University of Helsinki.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: We would like to thank the Ministry of Education and Culture of Finland for funding the LUMA FINLAND program and Veera Uusi-Äijö for assisting to finalize this paper. Open access funding provided by University of Helsinki.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. MOOC courses and number of questionnaire respondents.

	Number of Respondents (%)	
	preQ	**postQ**
Arjen ilmiöitä ja monialaisia projekteja LUMA-aineiden opetuksessa (Everyday Phenomena and Projects in STEAM Education)	28 (7.7%)	83 (46.9%)
GeoGebra opetuksessa (GeoGebra in Teaching)	106 (29.1%)	50 (28.3%)
Javan perusteita lyhyesti—webinaari (Java Basics in Short Webinar)	9 (2.5%)	-
Matematiikka ja luonnontieteet yhteiskunnassa—verkkokurssi koulu-yritysyhteistyöstä (Science and mathematics in society—An Online Course On School-Business Cooperation)	11 (3.0%)	-
MOOC-koulutus aiheesta peliohjelmoinnin alkeet Unitylla (Basics of game programming with Unity)	8 (2.2%)	3 (1.7%)
Ohjelmoinnin perusteita Pulmaario-tehtävien kautta—webinaari (webinar: Programming Basics Through "Pulmaario" Exercises)	17 (4.7%)	3 (1.7%)
Projektityöskentely matematiikan opetuksessa (project Work in Mathematics Education)	13 (3.4%)	1 (0.6%)
Tiede- ja teknologiakasvatus (science education)	50 (13.7%)	6 (3.4%)
Työelämätieto LUMA-aineiden opetuksessa (Work–Life Knowledge in STEM Eduation)	3 (0.8%)	-
Vahvuutta lukukäsitteeseen—ymmärrystä yhtälönratkaisuun (Towards the Better Understanding of Numbers and Equations)	119 (32.7%)	31 (17.5%)
Total	364	177

References

1. OECD. *TALIS 2018 Results (Volume II): Teachers and School Leaders as Valued Professionals*; OECD Publishing: Paris, France, 2020. [CrossRef]
2. Kaiser, G.; König, J. Competence Measurement in (Mathematics) Teacher Education and Beyond: Implications for Policy. *High. Educ.* **2019**, *32*, 597–615. [CrossRef]
3. Lavonen, J.; Mahlamäki-Kultanen, S.; Vahtivuori-Hänninen, S.; Mikkola, A. A Collaborative Design for a Finnish Teacher Education Development Programme. *J. Teac. Educ.* **2020**, *9*, 241–262.
4. Laurillard, D. The educational problem that MOOCs could solve: Professional development for teachers of disadvantaged students. *Res. Learn. Technol.* **2016**, *24*, 1–17. [CrossRef]
5. Kaul, M.; Aksela, M.; Wu, X. Dynamics of the Community of Inquiry (CoI) within a Massive Open Online Course (MOOC) for In-Service Teachers in Environmental Education. *Educ. Sci.* **2018**, *8*, 40. [CrossRef]
6. Matranga, A.; Silverman, J. An emerging community in online mathematics teacher professional development: An interactional perspective. *J. Math. Teach. Educ.* **2020**. [CrossRef]
7. Castaño-Muñoz, J.; Kalz, M.; Kreijns, K.; Punie, Y. Who is taking MOOCs for teachers' professional development on the use of ICT? A cross-sectional study from Spain. *Technol. Pedagog. Educ.* **2018**, *27*, 607–624. [CrossRef]
8. Powell, C.G.; Bodur, Y. Teachers' perceptions of an online professional development experience: Implications for a design and implementation framework. *Teach. Teach. Educ.* **2019**, *77*, 19–30. [CrossRef]
9. Stuckey, M.; Hofstein, A.; Mamlok-Naaman, R.; Eilks, I. The meaning of 'relevance' in science education and its implications for the science curriculum. *Stud. Sci. Educ.* **2013**, *49*, 1–34. [CrossRef]
10. Krapp, A.; Prenzel, M. Research on interest in science: Theories, methods, and findings. *Int. J. Sci. Educ.* **2011**, *33*, 27–50. [CrossRef]
11. Herranen, J.; Vesterinen, V.-M.; Aksela, M. How to measure elementary teachers' interest in teaching chemistry? *Chem. Educ. Res. Pr.* **2015**, *16*, 408–416. [CrossRef]

12. Aksela, M.; Vartiainen, J.; Tuomisto, M.; Turkka, J.; Pernaa, J.; Tolppanen, S. Promoting Meaningful Science Teaching and Learning Through ICT in the Finnish LUMA Ecosystem. In *New Ways to Teach and Learn in China and Finland: Crossing Boundaries with Technology*; Niemi, H., Jia, J., Eds.; Peter Lang: Frankfurt am Main, Germany, 2016; pp. 255–278.
13. Aksela, M.; Wu, X.; Halonen, J.E. Relevancy of the Massive Open Online Course (MOOC) about Sustainable Energy for Adolescents. *Educ. Sci.* **2016**, *6*, 40. [CrossRef]
14. Fore, G.A.; Feldhaus, C.R.; Sorge, B.H.; Agarwal, M.; Varahramyan, K. Learning at the nano-level: Accounting for complexity in the internalization of secondary STEM teacher professional development. *Teach. Teach. Educ.* **2015**, *51*, 101–112. [CrossRef]
15. Shulman, L. Knowledge and teaching: Foundations of the new reform. *Harv. Educ. Rev.* **1987**, *57*, 1–22. [CrossRef]
16. Kurup, P.M.; Li, X.; Powell, G.; Brown, M. Building future primary teachers' capacity in STEM: Based on a platform of beliefs, understandings and intentions. *Int. J. STEM Educ.* **2019**, *6*, 1–14. [CrossRef]
17. Darling-Hammond, L.; Hyler, M.E.; Gardner, M. *Effective Teacher Professional Development*; Learning Policy Institute: Palo Alto, CA, USA, 2017.
18. Van Aalsvoort, J. Activity theory as a tool to address the problem of chemistry's lack of relevance in secondary school chemistry education. *Int. J. Sci. Educ.* **2004**, *26*, 1635–1651. [CrossRef]
19. Sjøberg, S.; Schreiner, C. *The ROSE Project: An Overview and Key Findings*; University of Oslo: Oslo, Norway, 2010.
20. Misra, P. MOOCs for Teacher Professional Development: Reflections and Suggested Actions. *Open Prax.* **2018**, *10*, 67–77. [CrossRef]
21. Dillahunt, T.; Wang, Z.; Teasley, S.D. Democratizing higher education: Exploring MOOC use among those who cannot afford a formal education. *Int. Rev. Res. Open Dis.* **2014**, *15*, 177–196. [CrossRef]
22. Reich, J. Rebooting MOOC research. *Science* **2015**, *347*, 34–35. [CrossRef] [PubMed]
23. Lambert, S.R. Do MOOCs contribute to student equity and social inclusion? A systematic review 2014–18. *Comput. Educ.* **2020**, *145*, 103693. [CrossRef]
24. Christensen, G.; Steinmetz, A.; Alcorn, B.; Bennett, A.; Woods, D.; Emmanuel, E.J. The MOOC Phenomenon: Who Takes Massive Open Online Courses and Why? 2013. Available online: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2350964 (accessed on 30 March 2021).
25. Knapper, C. Does educational development matter? *Int. J. Acad. Dev.* **2016**, *21*, 105–115. [CrossRef]
26. Vivian, R.; Falkner, K.; Falkner, N. Addressing the challenges of a new digital technologies curriculum: MOOCs as a scalable solution for teacher professional development. *Res. Learn. Technol.* **2014**, *22*, 24691. [CrossRef]
27. Koukis, N.; Jimoyiannis, A. MOOCS for teacher professional development: Exploring teachers' perceptions and achievements. *Interact. Technol. Smart Educ.* **2019**, *16*, 74–91. [CrossRef]
28. Wambugu, P. Massive Open Online Courses (MOOCs) for Professional Teacher and Teacher Educator Development: A Case of TESSA MOOC in Kenya. *Univers. J. Educ. Res.* **2018**, *6*, 1153–1157. [CrossRef]
29. Reparaz, C.; Aznárez-Sanado, M.; Mendoza, G. Self-regulation of learning and MOOC retention. *Comput. Hum. Behav.* **2020**, *111*, 106423. [CrossRef]
30. Rafiq, K.R.M.; Hashim, H.; Yunus, M.M. MOOC for Training: A Review of The Variations Of MOOC. *Int. J. Innov. Creat. Chang.* **2019**, *5*, 90–98.
31. Warriem, J.M.; Murthy, S.; Iyer, S. Shifting the focus from Learner Completion to Learner Perseverance: Evidences from a Teacher Professional Development MOOC. In Proceedings of the 24th International Conference on Computers in Education, Bombay, India, 28 November–2 December 2016.
32. Bao, W. COVID-19 and online teaching in higher education: A case study of Peking University. *Hum. Behav. Emerg. Technol.* **2020**, *2*, 113–115. [CrossRef] [PubMed]
33. Hrastinski, S.; Keller, C.; Carlsson, S.A. Design exemplars for synchronous e-learning: A design theory approach. *Comput. Educ.* **2010**, *55*, 652–662. [CrossRef]
34. Østergaard, E.; Dahlin, B.; Hugo, A. Doing Phenomenology in Science Education. A Research Review. *Stud. Sci. Educ.* **2008**, *44*, 93–121. [CrossRef]
35. Baggaley, J. MOOC rampant. *Distance Educ.* **2013**, *34*, 368–378. [CrossRef]

education sciences

MDPI

Article

Professional Agency for Learning as a Key for Developing Teachers' Competencies?

Auli Toom [1,*], Kirsi Pyhältö [1], Janne Pietarinen [2] and Tiina Soini [3]

[1] Centre for University Teaching and Learning, University of Helsinki, 00100 Helsinki, Finland; kirsi.pyhalto@helsinki.fi
[2] Philosophical Faculty, University of Eastern Finland, 80101 Joensuu, Finland; janne.pietarinen@uef.fi
[3] Faculty of Education and Culture, Tampere University, 33100 Tampere, Finland; tiina.soini-ikonen@tuni.fi
* Correspondence: auli.toom@helsinki.fi

Abstract: Teacher's professional competencies have been discussed extensively in the literature, often linked to educational policy discourses, teaching standards, student learning outcomes, or the intended outcomes of teacher education. Extensive, but fragmented and loosely theoretically or empirically based lists of teacher competencies are provided without much clarification of how, when, and why teachers learn and identify the competencies they need. Teacher competencies and how they are related to the core of their work as thinking practice have been discussed extensively by a range of stakeholders. However, what is actually needed in order to attain such competencies has been less studied. This paper contributes to the gap in the literature on active and intentional learning of teacher competencies by elaborating the relationship between teacher competencies and professional agency for learning. Through this, our aim in this article is to provide a better understanding of the topic, both theoretically and empirically. Drawing on earlier research, we have elaborated on the relationships between a teacher's professional competencies and agency for learning among pre- and in-service teachers. We also aim to answer the question: what characteristics of teacher education lead to student teachers becoming competent and agentic? Why should we focus on those features during pre-service teacher education and as part of a teacher's career?

Keywords: teacher's professional agency; teacher competencies; teacher education; learning; professional development

Citation: Toom, A.; Pyhältö, K.; Pietarinen, J.; Soini, T. Professional Agency for Learning as a Key for Developing Teachers' Competencies? *Educ. Sci.* **2021**, *11*, 324. https://doi.org/10.3390/educsci11070324

Academic Editor: Eila Jeronen and Kirsi Tirri

Received: 2 May 2021
Accepted: 22 June 2021
Published: 29 June 2021

1. Introduction

Professionally competent and agentic teachers are expected to enhance instructional quality, meet students' needs, promote positive educational trajectories, school development, and pedagogical innovations [1–4]. The need for such qualities has been highlighted by researchers, practitioners, and policy makers [5,6]. In fact, competence has become a prominent part of educational policy discourse on teachers and their professional development, typically realized in extensive lists of teacher competence requirements. Interestingly, it seems that much of the research has adopted an approach similar to relying on the fragmented and loosely theoretically, empirically, or contextually-based lists of desired teacher competencies or even just drawing on OECD policy reports [7]. Less attention has been paid on how, when, and why teachers learn these competencies, how they are related to the core of teacher work as thinking practice [1], and what is needed in order to attain such competencies. More recently, teacher agency has been highlighted, particularly in the literature on school development, with teacher learning as a key to enhancing teacher commitment to continuing professional development and school development [8]. Research on teacher agency typically highlights the importance of a teacher's autonomy and active role in decision-making in regard to different aspects of their work [9]

There are several commonalities between research on a teacher's professional competencies and professional agency. Both of them tackle the complexity of teacher cognition

and behaviour [10–12], utilising elements of teacher knowledge in a sense that it emphasises the importance of the professional knowledge base for teaching [13,14]. In line with research on the 'reflective practitioner', they both emphasize continuous consideration of one's own and others' thoughts and behaviours as a key activity for developing in the teaching profession. Moreover, both professional competencies and professional agency are dynamic and constantly constructed [15,16]. Beyond these, the research trajectory on a teacher's professional agency perceives teachers as active learners with motivation to study efficacy beliefs of learning, and intentional acts for promoting knowledge [9,17], which primarily takes place in classrooms and in professional communities in schools. Research on a teacher's professional agency also recognises the professional interactions and contexts as integral and genuine elements for a teacher's agency and encourages investigating them [18].

Although research on teacher competencies and teacher agency have much in common, they are typically studied as separate constructs. Accordingly, the relationship between a teacher's professional agency for learning and knowledge of competencies for a teacher's work has not been systematically elaborated. Moreover, although extensively referred to in the literature, empirical studies tackling the question of teacher agency are still relatively rare. This paper contributes to the gap in the literature on active and intentional learning of teacher competencies by elaborating the relationship between teacher competencies and professional agency for learning. Our stance on teacher competencies stems from empirical research defining them as integrative constructs, including cognitive, motivational, and behavioural aspects i.e., knowledge, skills, and attitudes [16]. The competencies are learned, and provide core resources for a teacher's work. The professional agency, on the other hand, in addition to being a teacher's core capability in the sense that it offers a key for active and skilful teacher learning, also provides understanding of the dynamics of the preconditions for such learning in their work [15]. Yet, professional agency embodies a capacity that allows teachers to learn actively and skilfully, regulate their own learning, learning competencies needed in their work, develop professionally, promote students' and colleagues' learning, as well as innovate and promote change in schools [15]. Drawing on the socio-constructivist view on learning, in this article, our aim is to provide a better understanding of learning of teacher competencies, both theoretically and empirically by analysing their relationship. These constructs have been elaborated theoretically and investigated empirically in earlier research, but they have not been systematically analysed together before. Drawing on earlier research and empirical evidence, the relationship between a teacher's professional competencies and agency for learning during teacher education and in the profession is highlighted in this article, with focus on the former.

2. Teacher's Professional Competencies for the Work of Teaching

Teacher's competencies are often understood as integrative and complex constructs, including knowledge, skills, and disposition to act in professional situations [2,3,19,20]. In a theoretical and descriptive sense, competencies are cognitive structures that support certain teacher behaviours, and in an operational sense, competencies cover a variety of skills, allowing a teacher to act in complicated and changing professional situations, and finding solutions to them [2,16,20]. They are perceived as dynamic structures necessary for successful teaching [7,21]. Competencies are suggested to capture the core qualities of teachers' work, but lack clear operational definition [7,20] and focus. A range of "research-informed views on the teacher competence concept strive to find common ground beyond different cultural traditions, defining key knowledge, skills and attitudes that can be required of teachers, the role of professional standards, and basic characteristics of teacher expertise" [7]. This is due to the need to utilise the concept in empirical research work.

A variety of models and even lists of a teacher's core competencies, either as criteria for high quality teaching in classrooms and schools or as outcomes of pre-service or in-service teacher education, have been provided [17,22]. The fundamental premise for defining teacher competencies tends to emerge from the authenticity of teaching [23], identification

of the core characteristics of the practice of teaching, and analysis of teachers' broader professional tasks and responsibilities in society [24–27] currently and in the future. Thus, the close connection to the practice of teaching is common to all theorizations of teacher competencies [21], focusing primarily on the teachers' necessary capabilities for enhancing student learning, though the emphases of competencies are varied. The theorisations aim at being empirically relevant for research purposes. The models of teacher competencies especially aim at capturing teachers' necessary capabilities for facilitating the learning process and enhancing student learning. There exists a number of teachers' core competencies, which strive to define the necessary resources for teachers [28,29]. They tend to specify declarative and procedural pedagogical and subject-specific knowledge, value basis, motivational and reflective aspects, and professional development in teaching [22,25,30]. In addition, student-centred teaching, use of digital technologies, and teachers' professional collaboration are typically emphasized in the literature on competencies [31,32]. Some theorizations on teacher competencies focus on the classroom level, others stretch to the collegial and school levels, or even beyond. Some of the models are—without very strong empirical evidence or justifications—linked to national teaching standards and are explicated as the basis, learning goals, or outcomes for teacher education curricula [28]. Due to the lack of solid theoretical grounding or empirical evidence, these cannot be utilised in empirical research.

Many of the teacher competencies listed are discussed and elaborated in educational policy documents, while few of them rise from empirical research evidence. As such, they reflect evidence-based or research-informed understanding of quality teaching, good teachers' capabilities, and current (development) needs identified in schools. Thus, they are also presented normatively as characteristics and criteria for good teachers and teaching without a solid empirical foundation and research basis. These kinds of theorisations of teacher competencies are often linked to the current and changing demands of teacher accountability. At the same time, discussion (and even the research) is heavily driven by educational policies. Problems may arise if policy-driven conceptualisations of teacher competencies without having empirical evidence are applied in empirical research on teachers and teaching. As such, the requirements are more or less externally defined and do not give any advice to teachers on learning these competencies, or how they could facilitate other teachers' learning. Research on the learning of competencies during teacher education or in the profession is quite limited [3]. There is a limited number of studies investigating competencies as a continuum or gradually increasing capabilities leading to expertise in teaching [21,33,34]. This shows that the field of teacher competencies is relatively scattered, and a variety of understanding, approaches, and definitions of teacher competencies exists.

After finalizing pre-service teacher education, achieving professional competencies is primarily grounded in everyday work. From this perspective, it is crucial to identify what student teachers need to learn during teacher education in order to work and learn continuously in the teaching profession. What are the current conditions and what will they be in the future, for which student teachers would need to be prepared? How should student teachers' learning be supported during teacher education in a reasonable and sustainable way [30,35]? What professional agency should student teachers learn during teacher education so that they can regulate their own learning and be capable and competent throughout their career?

3. Teacher's Professional Agency for Learning in Classroom and Professional Community

Our approach on a teacher's professional agency for learning draws on the socio-constructivist view on learning, which we have empirically confirmed in our own research, and it refers to a teacher's intellect and the behavioural capacity needed for intentional and accountable orchestration of learning in a variety of contexts [9,36–39]. It entails the motivation to learn, efficacy beliefs of learning, and intentional acts for promoting one's own learning, colleagues' learning, student learning, and school development [9,17,40].

Thus, professional agency is an integrative concept comprising a teacher's cognitive, motivational, and attitudinal resources, as well as skills and abilities to promote and manage learning in a variety of professional contexts, particularly in the classroom with students and in the professional community with colleagues [41]. This entails self- and co-regulation of learning with and for the students and within the school community at large [42–44]. Professional agency can vary between the teachers and over time in various periods of the teaching career [45]. Accordingly, professional agency is not a permanent teacher trait. Rather, according to our understanding, it is constantly evolving via learning and as a result of the teacher–working environment dynamics. Thus, according to our view, a teacher's professional agency is neither only about the teacher's individual characteristics or traits as it is typically understood in purely psychological approaches, nor only about the institutional structures and power relations as it is often presented in sociological theorisations and approaches on human and professional agency [9]. Purely psychological or sociological approaches on agency in general and teacher agency emphasise different aspects of agency due to their fundamental premises, and thus, are realised in tensions between the different definitions. Consequently, a teacher's professional agency for learning is constantly constructed and re-constructed in a variety of contexts, objects of activity, and prior learning experiences [46,47]. With the aim of supporting student learning, identifying one's own and others' learning needs, learning professional competencies themselves, engaging in continuous professional development, and promoting pedagogical innovations and school developments, teachers need professional agency in the classroom, but also in their work community [9].

Professionally agentic teachers are characterized by perceiving learning as a fundamental part of their teaching [48], having an active and accountable stance for their own and others' learning and being motivated to develop professionally [8,37,39]. They perceive others as elemental resources for their own learning and are ready to invest their own resources for the best of individual and reciprocal collaborative learning processes [49,50]. Intentional self- and co-regulation of learning allow teachers to evaluate their own and others' learning and adjust their development towards better achievements in terms of their profession [9]. It allows teachers to identify their own learning needs and learn professional competencies they perceive that they lack. Teachers' strong sense of professional agency is realized in their understanding and will to enhance reciprocal learning with students and colleagues, experiment and integrate innovations to their teaching, develop through joint professional work, solve challenges together, build a professional community, utilize feedback from others, and support peers as well as be able to be supported [9,15]. This is related to their perceptions of themselves as teachers, how they are likely to promote others' learning, and develop their own pedagogical practices [51].

A teacher's professional agency is realized primarily in the classroom and in the professional community, which are the fundamental contexts of their work and in which the object of professional agency—students' learning, colleagues' learning and their own learning—is realised. Agentic teachers understand instruction as a reciprocal process in which they support students' learning, but also perceive students as resources for their own professional learning. Pedagogical interactions and practices allow and challenge teachers to reflect on their work and development continuously [52,53]. In the professional community, professional agency is about being responsible for their own learning and that of others, building a professional community intentionally, and facilitating collective efficacy among colleagues in terms of professional learning. This involves collective learning and even transformative efforts that are intended to make a difference both at the level of individual teachers and that of the entire teacher community [54]. Professional agency in the classroom and in the professional community are related both to the characteristics of individual teachers and their reciprocal relationships with others [55]. Thus, it is always situative and constructed in social interactions, implying that not all resources and opportunities for learning can be fruitfully utilized due to personal and contextual conditions. Professional agency is dynamic, and its development is regulated by a variety

of internal and external factors in a teacher's work [15]. As such, it is highly dependent on the teacher–working environment dynamics and cannot be reduced into either the individual teacher or the working environment attributes.

Results from some earlier studies also indicate that a teacher's professional agency is crucial for commitment to their work, students' learning, and agency development, but also towards school development and others' learning [56–59]. A teacher's professional agency is also shown to be related to decreased stress [9] and openness to innovative ideas [60,61]. Hence, teachers' capacity to transform their work intentionally and collectively is essential in terms of enhancing professional collaboration in their work.

To conclude, a teacher's professional agency provides an empirically-based conceptual tool with which to analyse and understand teacher learning. In contrast to teachers' professional competencies, it does not provide any perspectives on what teachers should learn.

4. Enhancing a Teacher's Professional Agency and Meaningful Learning of Competencies in Teacher Education and in the Profession

A teacher's professional agency is not only an individual trait, and accordingly, the professional agency both in the classroom and in the professional community can be learnt from the beginning of teacher education throughout the teaching career [9,15,62]. Teachers can also learn how to support others' agency. We perceive teachers' professional agency as a key capability required in a teacher's work: a key for their own, their colleagues', and pupils' learning and development. It brings a perspective of learning research into the discussion and allows to perceive teachers as active, responsible, and accountable professionals. We investigated its development among student teachers, early career teachers, and expert teachers. Since teacher learning is relational and contextual, the professional agency can be considered to be highly socially embedded and hence grounded in the interaction between teachers and students, and in general in the variety of contexts provided by the teacher's work and teacher education [36,47,63]. Teacher education learning environments and working contexts are continuously constructed through a variety of social interactions and practices that either significantly enhance or impede teachers' professional agency [9,17,42]. Based on our empirical research, we know that constructive interactions and social relationships providing opportunities for participation, enhancing engagement, and calling for everyone's contributions, are favourable for the development of a teacher's professional agency [47]. Well-functioning interactions with peers, respectful interactions, and equal opportunities for participation in teacher education are crucial in cultivating professional agency among student teachers [9,17]. Taking students' or colleagues' learning needs into account and building learning environments together is not easy. These may take time and definitely require identifying one's own learning needs and learning certain competencies beyond motivation and efficacy to do so.

Even at its best, a teacher's professional agency develops gradually during teacher education if student teachers are intentionally encouraged to act as professionals with an accountable stance towards their work [47]. Ideally, while learning to become a professional teacher, student teachers gradually cultivate their professional agency, including motivation, self-efficacy, and skills for promoting learning [9]. Student teachers' sense of professional agency in the classroom consists of learning in terms of reflection, modelling, building a collaborative learning environment, and competence, which are shown to be firmly related to and dependent of each other [53]. In addition, these modes of a teacher's professional agency change in the different phases of teacher education [53], meaning that they are in a reciprocal relationship with each other, and their role is different in different phases of their studies. Early career teachers have also been shown to experience challenges in building constructive classroom interaction [17] and in co-creating professional learning communities [64]. Professional agency calls for active involvement in the work of teaching, not only observing and reflecting on teaching [28,41]; yet mere involvement does not automatically result in professional agency. It is essential that student teachers are provided a variety of possibilities to practice and analyse teaching, as well as experiment with and enact their professional agency with their peers and pupils in the classroom. The

organization of teacher education and the pedagogies and assessment practices [35,65] utilized in the program influence the capabilities with which student teachers enter the teaching profession. Practices increasing the ability to act in professional situations and reflect on them have been shown to be efficient in teacher learning [66]. These practices simulate and allow to model real professional interactions, and thus encourage learning of professional agency, further resulting in learning of professional competencies. It is important to support student teacher learning in a variety of ways, and practice skills in the classroom repeatedly throughout teacher education [24–26] because learning of professional agency and instructional competencies takes time.

When teachers have the opportunities to encounter and overcome professional challenges with their peers and also with students in a good and safe atmosphere, they are more likely to co-regulate their learning with their peers and students [15,67]. While co-reflecting on their learning, they have the opportunity to identify the competencies they need to learn and build strategies for acquiring these competencies in the future. Positive relationships with peers are associated with efficacy in terms of learning [39] and efforts to promote their learning [68]. An environment that acknowledges teachers' initiatives and facilitates their co-regulated learning also promotes their professional agency [69,70]. All these elements contribute to teachers' potential to discover their strengths and areas of development in terms of the learning competencies needed in their work.

On the whole, the practices of the learning environment in teacher education and at work shape professional agency both in the classroom and in the work community [39,71]. It has been shown that tasks and practices requiring participation, co-regulation [15,67], collaboration, and social support [15] allow student teachers to develop their professional agency [9,72]. It has been found that significant learning experiences during the first year of studies and the first few years in the profession are necessary in transforming and expanding teachers' views of professional learning and development from the intrapersonal to the interpersonal level. This allows them to learn from each other and function as resources for each other's learning in their education and profession [9,73].

To conclude, a teacher's professional agency as an integrative capacity entailing motivation to learn, efficacy beliefs of learning, and skills for promoting and managing learning in a variety of professional contexts, particularly in the classroom with students and in the professional community, is a prerequisite for learning the professional competencies needed in the teaching profession. Through professional agency, teachers can identify their learning needs and enhance the competencies they individually or collectively perceive as being important. Professional agency allows teachers to learn professional competencies actively and meaningfully in their work based on the observations of the practice of teaching. By combining a teacher's professional agency and professional competencies in research, both the process and outcome of teacher learning can be potentially reached. Accordingly, professionally agentic teacher behaviour entails teachers' evaluation of the object of learning and based on this, selecting the most suitable course of action. This can include reflection on if and what needs to be learnt, which can occasionally also be at odds with the reform goals set by the policies, and lead to active resistance. However, without professional agency and hence the chance to manage one's own learning, professional competencies may remain fragmented, external, and hence less functional [33]. In the worst-case scenario, teachers are left poorly equipped with just external standards for facing the challenges provided by the profession. From this perspective, professional agency challenges the idea of externally pre-set uniform teacher standards—the view that is often embedded in the discourse on teacher competencies. On the other hand, with the professional competencies' component in the research, the perspectives of teacher's work can be better taken into account. The key characteristics and relationship between a teacher's professional agency and professional competencies are presented in Table 1.

Table 1. Teacher's professional agency as a key capability for learning professional competencies.

Teacher's Professional Agency	Teacher's Competencies
• Includes will, efficacy, and skills for learning • Object of agency is learning • Is contextual and relational • Teacher defines what she needs to learn • Is a prerequisite for meaningful and coherent teacher learning of professional competencies • Descriptive • Does not take a normative stance on what teachers should learn • Takes a stance on HOW teachers learn actively and skilfully	• Includes cognitive and behavioural component • Objects and focuses are many • Are defined in relation to teacher's work and personal capabilities • Strongly externally defined by policy makers, school authorities, teacher educators • Normative • Takes a stance on WHAT teachers should learn

To sum up, research on professional agency and teacher competencies take complementary but distinct stances on teacher learning. This is also realised in the efforts to combine the approaches and utilise them both in empirical research. They both also carry relatively heavy meanings and even ideological connotations, and thus, utilising them in research may cause further needs to explain and sharpen the definition in order to avoid unnecessary misunderstandings. The differences and similarities of the stances can be summarized as follows: Professional agency constitutes a teacher's will, efficacy, and skills for learning, while competencies are comprised of knowledge, skills, and attitudes. Accordingly, the constructs share the skill component. While the object of professional agency is learning, the objects of competence vary from how to teach mathematics to how to manage the classroom. While professional agency is perceived as being highly relational and contextual, competencies are typically considered to be individual constructs and qualities agreed in collective professional and educational policy discourses. Moreover, the competencies needed by the teachers are typically defined in line with the characteristics of the teacher's work by external stakeholders, such as policy makers, school authorities, and teacher educators, whereas the professional agency draws on the idea of strong teacher autonomy in terms of their own learning. Research on teacher's competencies takes a strong position on what teachers need to learn i.e., what competencies are needed in a teacher's work, while research on professional agency does not take a stance on what teachers should learn, but rather focuses on how they learn actively and skilfully.

5. Discussion

A teacher's professional agency and professional competencies are lines of teacher research that provide different conceptual structures for understanding teacher learning. A teacher's professional agency allows an understanding of active and skillful learning [15], whereas a teacher's professional competencies focus on investigating the contents and outcomes of teacher learning [17,21]. At their best, these two lines of research can also be perceived as complementing each other. A teacher's professional agency is a fundamental capacity for teachers and necessary to learn during teacher education. It allows teachers to enhance their own and others' learning and professional development as well as innovations and pedagogical developments in the professional community. It also allows teachers to identify and analyse their own learning needs in relation to the professional competencies required in a teacher's work over time, not only adopt distinct external requirements or adapt to the coincidental demands set from the outside. Professional competencies as such describe the key aspects of the work of teaching, but they do not focus on describing or providing tools for ways and processes of a teacher's own learning, or the learning of their colleagues or students. From the viewpoint of research, teacher education, a teacher's work in the profession, and all the choices related to teacher competencies are also value-laden and even ideologically related to the purpose of education that involve educational policy-making in certain educational and societal contexts [74]. In addition,

for these reasons, a teacher's professional agency, autonomy, and intentional management for their own and other's learning is essential.

When teachers both in pre-service teacher education and in the profession are challenged and provided with a variety of opportunities to try and experience transformative practices, they tend to foster them in their own work as teachers [75]. They also tend to foster agency among their own students [73]. The extent to which teachers learn a strong sense of professional agency during their early years in teacher education is related to their potential to act as empowering professional agents in their own work [47]. Thus, it is crucial that teachers are provided several and repeated opportunities to practice professional agency in teacher education, both with their peers and pupils in the classroom. This assumes a curriculum of teacher education and pedagogies of teacher education as well as teacher educators who are willing and able to provide this kind of learning experiences for student teachers. Enacting professional agency for learning is a long-lasting process that takes place in classroom interaction and in the professional community throughout a teaching career [74]. This is necessary for the teacher's own continuous learning and development in the profession.

From the viewpoint of research on teacher education, we believe it is important to discuss and analyse current emphases in teacher research on professional agency and professional competencies. They reflect the discourses and understandings of a teacher's work and demonstrate the current needs and emphases in research and in the practice of teaching. A teacher's professional agency is based on the conception of teachers as autonomous professionals in terms of their work and learning. It allows an investigation of how teachers learn and does not provide any norms or guidelines for what teachers should learn. IN contrast, research on a teacher's professional competencies is more firmly linked to educational policy discourses on a teacher's capabilities. It is more normative by nature, and thus a more challenging concept for empirical research. When combined, these two separate lines of teacher research could complement each other and pave the way for new comprehensive research lines. The research on ways and substance of teacher learning could solve challenges related to the research field and allow the practice of teaching and teacher education to be improved.

Author Contributions: Conceptualization, A.T., K.P., J.P. and T.S.; investigation, A.T., K.P., J.P. and T.S.; resources, A.T., K.P., J.P. and T.S.; writing—original draft preparation, A.T., K.P., J.P. and T.S; writing—review and editing, A.T., K.P., J.P. and T.S.; visualization, A.T. and K.P.; project administration, A.T., K.P., J.P. and T.S.; funding acquisition, A.T., K.P., J.P. and T.S. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Academy of Finland [Grant Number 326647].

Institutional Review Board Statement: The study did not involve humans.

Informed Consent Statement: The study did not involve humans.

Data Availability Statement: The study did not involve humans or empirical data.

Acknowledgments: Open access funding provided by University of Helsinki.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lampert, M. Studying Teaching as a Thinking Practice. In *Thinking Practices*; Greeno, J., Goldman, S.G., Eds.; Lawrence Erlbaum: Hillsdale, NJ, USA, 1998; pp. 53–78.
2. Korthagen, F.A.J. In Search of the Essence of a Good Teacher: Towards a More Holistic Approach in Teacher Education. *Teach. Teach. Educ.* **2004**, *20*, 77–97. [CrossRef]
3. Struyven, K.; De Meyst, M. Competence-Based Teacher Education: Illusion or Reality? An Assessment of the Implementation Status in Flanders from Teachers' and Students' Points of View. *Teach. Teach. Educ.* **2010**, *26*, 1495–1510. [CrossRef]
4. Pantic, N.; Florian, L. Developing Teachers as Agents of Inclusion and Social Justice. *Educ. Inq.* **2015**, *6*, 333–351. [CrossRef]
5. OECD. *Teachers Matter: Attracting, Developing and Retaining Effective Teachers*; OECD Publications: Paris, France, 2005.
6. Zeichner, K.M. *Teacher Education and the Struggle for Social Justice*; Routledge: London, UK, 2009.

7. Caena, F. Teacher Competence Frameworks in Europe: Policy-as-Discourse and Policy-as-Practice. *Eur. J. Educ.* **2014**, *49*, 311–331. [CrossRef]
8. Priestley, M.; Biesta, G.J.J.; Robinson, S. *Teacher Agency: An Ecological Approach*; Bloomsbury Academic: London, UK, 2015.
9. Toom, A.; Pyhältö, K.; O'Connell Rust, F. Teacher's Professional Agency in Contradictory Times. *Teach. Teach. Theory Pract.* **2015**, *21*, 615–623. [CrossRef]
10. Gage, N. *Handbook of Research on Teaching*; McNally: Chicago, IL, USA, 1964.
11. Clark, C.M.; Peterson, P.L. Teachers' Thought Processes. In *Handbook of Research on Teaching*, 3rd ed.; Wittrock, M.C., Ed.; Macmillan: New York, NY, USA, 1986; pp. 255–296.
12. Richardson, V. (Ed.) *Handbook of Research on Teaching*; American Educational Research Association: Washington, DC, USA, 2004.
13. Shulman, L.S. Those Who Understand: Knowledge Growth in Teaching. *Educ. Res.* **1986**, *15*, 4–14. [CrossRef]
14. Fenstermacher, G.D. The Knower and the Known: The Nature of Knowledge in Research on Teaching. In *Review of Research in Education, 20*; Darling-Hammond, L., Ed.; American Educational Research Association: Washington, DC, USA, 1994; pp. 3–56.
15. Saariaho, E.; Pyhältö, K.; Toom, A.; Pietarinen, J.; Soini, T. Student Teachers' Self- and Co-regulation of Learning during Teacher Education. *Learn. Res. Pract.* **2016**, *2*, 44–63. [CrossRef]
16. Blömeke, S.; Delaney, S. Assessment of Teacher Knowledge across Countries: A Review of the State of Research. *ZDM Math. Educ.* **2012**, *44*, 223–247. [CrossRef]
17. Heikonen, L.; Pietarinen, J.; Pyhältö, K.; Toom, A.; Soini, T. Early Career Teachers' Sense of Professional Agency in the Classroom: Associations with Turnover Intentions and Perceived Inadequacy in Teacher-student Interaction. *Asia-Pac. J. Teach. Educ.* **2017**, *45*, 250–266. [CrossRef]
18. Cochran-Smith, M.; Villegas, A.M. Research on Teacher Preparation: Charting the Landscape of a Sprawling Field. In *Handbook of Research on Teaching*, 5th ed.; Gitomer, D.G., Bell, C.A., Eds.; American Educational Research Association: Washington, DC, USA, 2016; pp. 439–548.
19. Koster, B.; Brekelmans, M.; Korthagen, F.; Wubbels, T. Quality Requirements for Teacher Educators. *Teach. Teach. Educ.* **2005**, *21*, 157–176. [CrossRef]
20. Westera, W. Competences in Education: A Confusion of Tongues. *J. Curric. Stud.* **2001**, *33*, 75–88. [CrossRef]
21. Blömeke, S.; Gustafsson, J.; Shavelson, R.J. Beyond Dichotomies: Competence Viewed as a Continuum. *Z. Für Psychol.* **2015**, *223*, 3–13. [CrossRef]
22. Baumert, J.; Kunter, M. Stichwort: Professionelle Kompetenz von Lehrkräften. *Z. Für Erzieh.* **2006**, *9*, 469–520. [CrossRef]
23. Hiebert, J.; Morris, A.K.; Berk, D.; Jansen, A. Preparing teachers to learn from teaching. *J. Teach. Educ.* **2007**, *58*, 47–61. [CrossRef]
24. Darling-Hammond, L. Constructing 21st Century Teacher Education. *J. Teach. Educ.* **2006**, *57*, 300–314. [CrossRef]
25. Pantic, N.; Wubbels, T. Teacher Competencies as a Basis for Teacher Education—Views of Serbian Teachers and Teacher Educators. *Teach. Teach. Educ.* **2010**, *26*, 694–703. [CrossRef]
26. Pantic, N.; Wubbels, T. Competence-Based Teacher Education: A Change from Didaktik to Curriculum Culture? *J. Curric. Stud.* **2012**, *44*, 61–87. [CrossRef]
27. Pantic, N.; Wubbels, T.; Mainhard, T. Teacher Competence as a Basis for Teacher Education: Comparing Views of Teachers and Teacher Educators in Five Western Balkan Countries. *Comp. Educ. Rev.* **2011**, *55*, 165–188. [CrossRef]
28. Munby, H.; Russell, T.; Martin, A.K. Teachers' Knowledge and How It Develops. In *Handbook of Research on Teaching*, 4th ed.; Richardson, V., Ed.; American Educational Research Association: Washington, DC, USA, 2001; pp. 877–904.
29. Shulman, L.S. Knowledge and Teaching: Foundations of the New Reform. *Harv. Educ. Rev.* **1987**, *57*, 1–22. [CrossRef]
30. Gitomer, D.H.; Zisk, R.C. Chapter 1: Knowing What Teachers Know. *Rev. Res. Educ.* **2015**, *39*, 1–53. [CrossRef]
31. Kereluik, K.; Mishra, P.; Fahnoe, C.; Terry, R. What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning. *J. Digit. Learn. Teach. Educ.* **2013**, *29*, 127–140. [CrossRef]
32. Schleicher, A. (Ed.) *Preparing Teachers and Developing School Leaders for the 21st Century: Lessons from around the World*; OECD Publishing: Paris, France, 2012.
33. Berliner, D.C. Learning About and Learning from Expert Teachers. *Int. J. Educ. Res.* **2001**, *35*, 463–482. [CrossRef]
34. Fenstermacher, G.D.; Richardson, V. On Making Determinations of Quality in Teaching. *Teach. Coll. Rec.* **2005**, *107*, 186–213. [CrossRef]
35. Shavelson, R.J. On an Approach to Testing and Modeling Competence. *Educ. Psychol.* **2013**, *48*, 73–86. [CrossRef]
36. Edwards, A. Relational Agency: Learning to Be a Resourceful Practitioner. *Int. J. Educ. Res.* **2005**, *43*, 168–182. [CrossRef]
37. Sachs, J. The Activist Professional. *J. Educ. Chang.* **2000**, *1*, 77–94. [CrossRef]
38. Turnbull, M. Student Teachers Professional Agency in the Practicum: Myth or Possibility? Ph.D. Thesis, Curtin University of Technology, Perth, Australia, 2002, unpublished.
39. Turnbull, M. Student Teacher Professional Agency in the Practicum. *Asia-Pac. J. Teach. Educ.* **2005**, *33*, 195–208. [CrossRef]
40. Pietarinen, J.; Pyhältö, K.; Soini, T.; Salmela-Aro, K. Reducing Teacher Burnout: A Socio-contextual Approach. *Teach. Teach. Educ.* **2013**, *35*, 62–72. [CrossRef]
41. Pyhältö, K.; Pietarinen, J.; Soini, T. Comprehensive School Teachers' Professional Agency in Large-scale Educational Change. *J. Educ. Chang.* **2012**, *15*, 303–325. [CrossRef]
42. Edwards, A.; D'Arcy, C. Relational Agency and Disposition in Sociocultural Accounts of Learning to Teach. *Educ. Rev.* **2004**, *56*, 147–155. [CrossRef]

43. Kwakman, K. Factors Affecting Teachers' Participation in Professional Learning Activities. *Teach. Teach. Educ.* **2003**, *19*, 149–170. [CrossRef]
44. Pyhältö, K.; Pietarinen, J.; Soini, T. Do Comprehensive School Teachers Perceive Themselves as Active Professional Agents in School Reforms? *J. Educ. Chang.* **2012**, *13*, 95–116. [CrossRef]
45. Pyhältö, K.; Pietarinen, J.; Toom, A.; Haverinen, K.; Beijaard, D.; Soini, T. Trajectories of Secondary Teacher Students' Professional Agency in Classroom. *Eur. J. Teach. Educ.*. submitted.
46. Emirbayer, M.; Mische, A. What is Agency? *Am. J. Sociol.* **1998**, *103*, 962–1023. [CrossRef]
47. Lipponen, L.; Kumpulainen, K. Acting as Accountable Authors: Creating Interactional Spaces for Agency Work in Teacher Education. *Teach. Teach. Educ.* **2011**, *27*, 812–819. [CrossRef]
48. Van Eekelen, I.M.; Vermunt, J.D.; Boshuizen, H.P.A. Exploring Teachers' Will to Learn. *Teach. Teach. Educ.* **2006**, *22*, 408–423. [CrossRef]
49. Hakkarainen, K.; Paavola, S.; Lipponen, L. From Communities of Practice to Innovative Knowledge Communities. *LLine Lifelong Learn. Eur.* **2004**, *9*, 74–83.
50. Rogoff, B.; Matusov, E.; White, C. Models of Teaching and Learning: Participation in a Community of Learners. In *Handbook of Education and Human Development: New Models of Learning, Teaching, and Schooling*; Olson, D., Torrance, N., Eds.; Basil Blackwell: London, UK, 1996; pp. 388–414.
51. Jääskelä, P.; Poikkeus, A.-M.; Vasalampi, K.; Valleala, U.M.; Rasku-Puttonen, H. Assessing Agency of University Students: Validation of the AUS Scale. *Stud. High. Educ.* **2016**. [CrossRef]
52. Beijaard, D. Teachers' Prior Experiences and Actual Perceptions of Professional Identity. *Teach. Teach. Theory Pract.* **1995**, *1*, 281–294. [CrossRef]
53. Heikonen, L.; Pietarinen, J.; Toom, A.; Soini, T.; Pyhältö, K. The Development of Student Teachers' Sense of Professional Agency in the Classroom During Teacher Education. *Learn. Res. Pract.* **2020**. [CrossRef]
54. Sannino, A.; Engeström, Y.; Lemos, M. Formative Interventions for Expansive Learning and Transformative Agency. *J. Learn. Sci.* **2016**. [CrossRef]
55. Greeno, J.G. Authoritative, Accountable Positioning and Connected, General knowing: Progressive Themes in Understanding Transfer. *J. Learn. Sci.* **2006**, *15*, 537–547. [CrossRef]
56. Arnold, J.; Clarke, D.J. What Is 'Agency'? Perspectives in Science Education Research. *Int. J. Sci. Educ.* **2014**, *36*, 735–754. [CrossRef]
57. Pyhältö, K.; Pietarinen, J.; Soini, T. Teachers' Professional Agency and Learning—From Adaption to Active Modification in the Teacher Community. *Teach. Teach. Theory Pract.* **2015**, *21*, 811–830. [CrossRef]
58. Edwards, A. Recognizing and Realizing Teachers' Professional Agency. *Teach. Teach. Theory Pract.* **2015**, *21*, 779–784. [CrossRef]
59. Eteläpelto, A.; Vähäsantanen, K.; Hökkä, P.; Paloniemi, P. What is Agency? Conceptualizing Professional Agency at Work. *Educ. Res. Rev.* **2013**, *10*, 45–65. [CrossRef]
60. Day, C.; Elliot, B.; Kington, A. Reform, Standards and Teacher Identity: Challenges of Sustaining Commitment. *Teach. Teach. Educ.* **2005**, *21*, 563–577. [CrossRef]
61. Linnenbrink-Garcia, L.; Kempler Rogat, T.; Koskey, K.L.K. Affect and Engagement during Small Group Instruction. *Contemp. Educ. Psychol.* **2011**, *36*, 13–24. [CrossRef]
62. Conway, P.F.; Clark, C.M. The Journey Inward and Outward: A Reexamination of Fuller's Concerns-Based Model of Teacher Development. *Teach. Teach. Educ.* **2003**, *19*, 465–482. [CrossRef]
63. Edwards, A. Relational Agency in Professional Practice: A CHAT Analysis. *ACTIO Int. J. Hum. Act. Theory* **2007**, *1*, 1–17.
64. Beauchamp, C.; Thomas, L. New Teachers' Identity Shifts at the Boundary of Teacher Education and Initial Practice. *Int. J. Educ. Res.* **2011**, *50*, 6–13. [CrossRef]
65. Ball, D.L.; Forzani, F.M. The Work of Teaching and the Challenge for Teacher Education. *J. Teach. Educ.* **2009**, *60*, 497–511. [CrossRef]
66. Husu, J.; Toom, A.; Patrikainen, S. Guided reflection as a means to demonstrate and develop student teachers' reflective competencies. *Reflective Pract.* **2008**, *9*, 37–51. [CrossRef]
67. Saariaho, E.; Toom, A.; Soini, T.; Pietarinen, J.; Pyhältö, K. Student-teachers' and Pupils' Co-regulated Learning Behaviours in Authentic Classroom Situations in Teaching Practice. *Teach. Teach. Educ.* **2019**. [CrossRef]
68. Lonka, K.; Ketonen, E. How to Make a Lecture Course an Engaging Learning Experience? *Stud. Learn. Soc.* **2012**, *2*, 63–74. [CrossRef]
69. Borko, H. Professional Development and Teacher Learning: Mapping the Terrain. *Educ. Res.* **2004**, *33*, 3–15. [CrossRef]
70. Grossman, P. The Teaching of Practice in Teacher Education. In *Making a Difference: Challenges for Teachers, Teaching and Teacher Education*; Butcher, J., McDonald, L., Eds.; Sense Publishers: Rotterdam, The Netherlands, 2007; pp. 55–65.
71. Donche, V.; Van Petegem, P. The Development of Learning Patterns of Student Teachers: A Cross-Sectional and Longitudinal Study. *High. Educ.* **2009**, *57*, 463–475. [CrossRef]
72. Korthagen, F.A.J. Situated Learning Theory and the Pedagogy of Teacher Education: Towards an Integrative View of Teacher Behavior and Teacher Learning. *Teach. Teach. Educ.* **2010**, *26*, 98–106. [CrossRef]
73. Heikkilä, A.; Lonka, K.; Nieminen, J.; Niemivirta, M. Relations between Teacher Students' Approaches to Learning, Cognitive and Attributional Strategies, Well-being and Study Success. *High. Educ.* **2012**, *64*, 455–471. [CrossRef]
74. Cochran-Smith, M. *Policy, Practice, and Politics in Teacher Education*; Corwin Press: Thousand Oaks, CA, USA, 2006.
75. Ketelaar, E.; Beijaard, D.; Boshuizen, H.P.A.; Den Brok, P.J. Teachers' Positioning Towards an Educational Innovation in the Light of Ownership, Sensemaking and Agency. *Teach. Teach. Educ.* **2012**, *28*, 273–282. [CrossRef]

MDPI
St. Alban-Anlage 66
4052 Basel
Switzerland
Tel. +41 61 683 77 34
Fax +41 61 302 89 18
www.mdpi.com

Education Sciences Editorial Office
E-mail: education@mdpi.com
www.mdpi.com/journal/education

MDPI
St. Alban-Anlage 66
4052 Basel
Switzerland

Tel: +41 61 683 77 34
Fax: +41 61 302 89 18

www.mdpi.com

ISBN 978-3-0365-1689-9