Helsinki Studies in Education, number 72

Jenni Sullanmaa

Coherence making in large-scale curriculum reform

How do educational stakeholders perceive curriculum coherence and why does it matter?

Doctoral dissertation, to be presented for public discussion with the permission of the Faculty of Educational Sciences of the University of Helsinki, in the lecture hall 302, Siltavuorenpenger 3A, on Wednesday 15th of April, 2020 at 12 o'clock.

Helsinki 2020

University of Helsinki, Faculty of Educational Sciences
Helsinki Studies in Education, number 72

Jenni Sullanmaa

Coherence making in large-scale curriculum reform
How do educational stakeholders perceive curriculum coherence and why does it matter?

Abstract
This dissertation presents an exploration of the anatomy and function of curriculum coherence as perceived by educational stakeholders in national core curriculum reform in basic education. It presents analysis of how educational stakeholders from three levels of the educational system experienced the core curriculum's coherence, and whether there were differences within and between the levels. In addition, the study included an examination of whether curriculum coherence is connected to the impact of the reform process on school-level development. The dissertation is comprised of three independent part studies. The study was conducted with quantitative methods, combining variable-centered and person-centered analyses. Survey data were collected from three cohorts: state-level stakeholders involved in core curriculum development ($N = 116$), district-level stakeholders involved in local curriculum development ($N = 550$) and comprehensive school teachers at two time points in the early stages of implementing the curriculum in schools ($N = 901$).

The results showed that perceived curriculum coherence consisted of: 1) consistency of the intended direction, 2) an integrative approach to teaching and learning, and 3) alignment between objectives, content and assessment (*study I*). Overall, the state-level stakeholders seemed to have the highest perceptions of the core curriculum's coherence and teachers the lowest. While all participant cohorts perceived the core curriculum to be rather coherent, the consistency of the curriculum's intended direction was seen as the least successful element of coherence. The person-centered analyses provided more detailed information about the variation in perceived curriculum coherence within and between the levels of the educational system.

Two distinctive profiles were identified among state- and district-level stakeholders in *study II*. Stakeholders in the *high coherence and impact* profile (83%) experienced the core curriculum to be coherent in terms of all three elements and expected the reform process to have positive impact on school-level development work. In turn, stakeholders in the *lower consistency of the intended direction and impact* profile (17%) perceived the consistency of the intended direction to be lower, combined with less positive expectations of the school-level

impact. State-level stakeholders had higher odds of belonging to the *high coherence and impact* profile compared to the district-level stakeholders.

In *study III*, five profiles were identified based on teachers' perceived curriculum coherence at two time points during the early stage of curriculum implementation. Teachers in the largest profiles, *high* (21%) and *high-moderate coherence* (48%), experienced the core curriculum to be coherent, however their perceived coherence slightly decreased during the one-year follow-up. In turn, teachers in the *low-moderate* (20%) and *low coherence* (3%) profiles perceived the core curriculum to be less coherent at first but their perceptions slightly increased after the first year of implementation. Finally, the *decreasing coherence* (9%) profile had rather low initial perceived coherence and showed a large drop during the follow-up.

The results also showed that district-level stakeholders' perceptions of the core curriculum's coherence were strongly connected to their expectations of the reform's impact on functional school development (*study I*). Moreover, teachers' curriculum coherence profiles differed in terms of their perceptions of the school impact: the more coherent teachers perceived the core curriculum, the more positive they considered the impact of the reform to be on school-level development work (*study III*).

The dissertation contributes to the research on curriculum reform by a) exploring the anatomy of curriculum coherence as perceived by educational stakeholders, b) showing that curriculum coherence is connected to the potential of the reform to support locally functional school development, c) providing a systemic inquiry of perceived curriculum coherence at various levels of the educational system in the context of large-scale curriculum reform, and d) utilizing both variable-centered and person-centered analytical approaches to gain more detailed information on perceived curriculum coherence throughout the system.

Jenni Sullanmaa

Koherenssin rakentaminen kansallisessa opetussuunnitelmauudistuksessa
Kuinka koulun toimijat kokevat opetussuunnitelman koherenssin ja miksi sillä on
väliä?

Tiivistelmä
Tässä väitöstutkimuksessa tarkasteltiin opetussuunnitelman koherenssin, eli sen
yhtenäisyyden ja johdonmukaisuuden, rakennetta ja merkitystä koulun
toimijoiden kokemana kansallisten perusopetuksen opetussuunnitelman
perusteiden uudistuksessa. Tutkimuksessa tarkasteltiin, kuinka koulujärjestelmän
eri toimijat kokivat uudistetun opetussuunnitelman koherenssin sekä sitä,
erosivatko näkemykset koulujärjestelmän eri tasoilla ja niiden välillä. Lisäksi
tutkittiin, onko opetussuunnitelman koherenssi yhteydessä odotuksiin
uudistuksen vaikuttavuudesta koulutasolla. Väitöstutkimus koostuu kolmesta
itsenäisestä osatutkimuksesta. Tutkimus toteutettiin kvantitatiivisilla
menetelmillä hyödyntäen sekä muuttuja- että yksilökeskeisiä lähestymistapoja.
Kyselyaineisto kerättiin kolmelta koulujärjestelmän tasolta: kansallisen tason
opetussuunnitelman perusteiden kehittämiseen osallistuneilta toimijoilta (N =
116), paikallistason opetussuunnitelmatyöryhmiin osallistuneilta toimijoilta (N =
550), sekä peruskoulun opettajilta kahdella mittauskerralla opetussuunnitelman
toteutuksen alkuvaiheessa (N = 901).

Tulosten perusteella näkemykset opetussuunnitelman koherenssista
koostuivat: 1) tavoitellun suunnan johdonmukaisuudesta, 2) opetusta eheyttävästä
lähestymistavasta sekä 3) tavoitteiden, sisältöjen ja arvioinnin linjakkuudesta
(*osatutkimus I*). Yleisesti ottaen kansallistason toimijat kokivat
opetussuunnitelman perusteet eniten koherenteiksi ja opettajat vähiten. Vaikka
kaikkien vastaajaryhmien näkemysten perusteella opetussuunnitelman perusteet
olivat melko koherentit, tavoitellun suunnan johdonmukaisuus koettiin
koherenssin ulottuvuuksista matalimmaksi. Yksilökeskeiset analyysit antoivat
lisätietoa tasojen sisäisestä ja välisestä vaihtelusta.

Osatutkimuksessa II kansallisen ja paikallisen tason toimijoiden keskuudesta
tunnistettiin kaksi erilaista profiilia. *Korkean koherenssin ja vaikuttavuuden*
ryhmään kuuluneet toimijat (83%) kokivat opetussuunnitelman perusteet
koherenteiksi kaikkien kolmen ulottuvuuden suhteen sekä samaan aikaan
odottivat, että opetussuunnitelmauudistusprosessi vaikuttaa positiivisesti
koulutason kehittämistyöhön. *Matalan johdonmukaisuuden ja vaikuttavuuden*
ryhmään kuuluneet toimijat (17%) sen sijaan kokivat opetussuunnitelman
perusteiden tavoitellun suunnan johdonmukaisuuden matalammaksi ja samalla

heidän uskomuksensa uudistuksen koulutason vaikuttavuudesta olivat heikommat. Kansallistason toimijat kuuluivat todennäköisemmin *korkean koherenssin ja vaikuttavuuden* profiiliin verrattuna paikallistason toimijoihin.

Osatutkimuksessa III tunnistettiin viisi koetun koherenssin profiilia opettajien kahden mittauskerran vastausten perusteella. Opettajat suurimmissa profiileissa, *korkea* (21 %) ja *korkea-kohtalainen koherenssi* (48 %), kokivat opetussuunnitelman perusteet koherenteiksi, vaikka heidän näkemyksensä koherenssista laskivat hieman opetussuunnitelman toteuttamisen alkuvaiheissa. *Matala-kohtalainen* (20 %) sekä *matala koherenssi* (3 %) ryhmiin kuuluneet opettajat sen sijaan kokivat opetussuunnitelman koherenssin vähäisenä ensimmäisellä vastauskerralla, mutta koettu koherenssi kasvoi hieman opetussuunnitelman toteuttamisen alkuvaiheessa. *Laskevan koherenssin* (9 %) ryhmän näkemykset opetussuunnitelman koherenssista olivat matalat sekä laskivat edelleen vuoden seurannan aikana.

Lisäksi tulokset osoittivat, että paikallistason toimijoiden näkemykset opetussuunnitelman perusteiden yhtenäisyydestä kolmella koherenssin ulottuvuudella olivat vahvasti yhteydessä heidän arvioihinsa opetussuunnitelmauudistuksen vaikutuksesta koulujen kehittämistyöhön, esimerkiksi opettajien sitoutumiseen ja paikallisesti toimivaan kehittämistyöhön (*osatutkimus I*). Lisäksi opettajien koetun koherenssin profiilit erosivat uskomuksissa koulutason vaikutuksista; mitä koherentimmiksi opetussuunnitelman perusteet koettiin, sen vahvemmiksi arvioitiin uudistuksen vaikutukset koulutason kehittämistyössä (*osatutkimus III*).

Väitöstutkimus edistää opetussuunnitelmauudistuksiin liittyvää tutkimusta seuraavilla tavoilla: a) tarkastelemalla opetussuunnitelman koherenssin rakennetta koulujärjestelmän toimijoiden kokemana, b) osoittamalla, että koettu opetussuunnitelman koherenssi on yhteydessä uudistuksen odotettuun vaikuttavuuteen koulun kehittämistyössä, c) tarjoamalla systeemisen tarkastelun koetusta koherenssista koulujärjestelmän kolmella eri tasolla sekä d) hyödyntämällä muuttuja- ja yksilökeskeisiä lähestymistapoja aineiston analyysissa.

Avainsanat: opetussuunnitelman koherenssi, opetussuunnitelmauudistus, peruskoulu, koulun kehittäminen

Acknowledgements

I first became interested in being a researcher when I wrote my master's thesis. The curiosity and opportunity to find something new made it a surprisingly positive and inspiring experience for me. When the opportunity to undertake doctoral studies turned up, I couldn't decline. Now that the phase of studying to become a researcher is coming to an end, I would like to thank everyone that has made an impact on this journey and supported me during the process.

First of all, I want to express my profound gratitude to my main supervisor Kirsi Pyhältö, who made this dissertation and its completion possible. I cannot thank you enough for offering me the opportunity to join this research group. Thank you for always having the time for me, and for all the feedback, discussions and encouragement. I am also very grateful to Janne Pietarinen and Tiina Soini, my other two supervisors, both of whom have had a huge role in this dissertation and have always guided and supported me in every part of the process. I am grateful to have learned from all three of my supervisors and their expertise. With the encouraging research group and three supporting supervisors, the doctoral study process became a straightforward one.

I want to thank the pre-examiners Nienke Nieveen and Päivi Atjonen for providing constructive comments on an earlier version of this dissertation. I also wish to express my gratitude to Professor Emeritus Jan van den Akker for accepting the role of opponent at the public defence of the dissertation. I am also grateful to Ian Dobson for the thorough language revisions and useful comments on my texts. Moreover, I want to thank the Faculty of Educational Sciences at the University of Helsinki for the doctoral student position, as well as the Ministry of Education and Culture and the Academy of Finland for the financial support for the research project. I would also like to give special thanks to all the participants of the School Matters -research project.

I wish to thank all my colleagues in the research group and in the broader academic community who have given me encouragement and helpful comments, questioned things that I had taken for granted, and provided all kinds of professional and emotional support. In particular, Lotta, Henrika, Lauri and Emmi, all of you have been role models for me. You have provided excellent comments on the research as well as patiently helped me with a range of issues during this process. In addition, Kaisa, all of your help with quantitative methods has made a huge difference to my learning process. I am grateful that I had the opportunity to work with all of you.

Apart from academic life, I am very grateful to all of my friends for the support, encouragement and positive distraction. Thanks also to my two brothers who have been my role models and since childhood have pushed me to do the best that I

can. Tuija, my mother, you raised me to have a curious and critical mind. Without you, I probably wouldn't have made my way to the university in the first place. Most importantly, my beloved Joni, I thank you for always being there for me. You seem to have endless faith in me, and your encouragement means everything. At the same time, you always know to tell me when I worry about something insignificant. Thanks to you, I remember what is most meaningful in life.

I dedicate this dissertation to the memory of my father, Seppo.

Espoo, February 2020
Jenni Sullanmaa

Contents

List of figures

List of tables

List of appendices

List of original articles

This doctoral dissertation is based on the following three original publications, which are referred to in the text based on their Roman numerals (I–III):

I   Sullanmaa, J., Pyhältö, K., Pietarinen, J. & Soini, T. (2019). Curriculum coherence as perceived by district-level stakeholders in large-scale national curriculum reform in Finland. *The Curriculum Journal, 30*(3), 244–263.

II   Sullanmaa, J., Pyhältö, K., Pietarinen, J. & Soini, T. (2019). Differences in state- and district-level stakeholders' perceptions of curriculum coherence and school impact in national curriculum reform. *Journal of Educational Administration, 57*(3), 210–226.

III   Sullanmaa, J., Pyhältö, K., Soini, T. & Pietarinen, J. (2019). Trajectories of teachers' perceived curriculum coherence in the context of Finnish core curriculum reform. *Curriculum and Teaching, 34*(2), 27–49.

The original publications are reprinted with the kind permission of the copyright holders.

1 Introduction

As school systems are racing to keep up with rapidly changing societies, curriculum reforms are central instruments in the change. To accommodate the societal changes and the demands of the changing work environments, many educational systems have recently introduced school reforms, emphasizing global trends such as readiness for lifelong learning and 21st century skills. The core curriculum for basic education in Finland was reformed in 2014. Its aim is to promote active involvement of pupils, collaborative and integrative learning methods and versatile learning environments. The core curriculum provides a national framework for local curricula and school practice and thus, the reform launched a process of local curriculum development in municipalities and districts. Phased implementation of the new curriculum in schools started in 2016.

However, large-scale changes in educational systems have been shown to be difficult to implement, often resulting in little or superficial change in the classroom practice (Fullan, 2007). Reasons for this include lack of clarity in the reform's goals and fragmentation in the new curriculum experienced by those responsible for translating the reform into practice (see Smith & O'Day, 1991; van den Akker, 2003). In contrast, it has been suggested that curriculum coherence in terms of connectedness, integration, and continuity within the curriculum, forms a sustainable basis for curriculum development (e.g. Beane, 1995). Moreover, it has been suggested that a sufficiently coherent and shared understanding of the aim and function of the curriculum and its meaning for school development by administrators and educational practitioners throughout the system promotes curriculum implementation (see Fullan, 2007; Lasky, Datnow & Stringfield, 2005; Pietarinen, Pyhältö & Soini, 2017).

Educational stakeholders' and teachers' understandings of curriculum change are especially important in the Finnish curriculum reform, since it involves local stakeholders and practitioners in local curriculum development work in order to foster ownership of the change in schools (Mølstad, 2015; Vitikka, Krokfors & Rikabi, 2016; Salminen, 2018). The local education providers in Finland have considerable autonomy in organizing education and constructing a local curriculum in the framework of the national core curriculum, emphasizing locally relevant content, needs and resources. Moreover, Finnish teachers are trusted professionals who have pedagogical autonomy in choosing their teaching methods and materials. Thus, the success of the national curriculum reform is highly dependent on how the stakeholders throughout the educational system understand the direction of the change being aimed at. Previous studies examining curriculum and earlier reforms in Finland have indicated that teachers vary in their perceptions and use of the curriculum and competence regarding its development

(see e.g. Atjonen, 1993; Heinonen, 2005; Kosunen, 1994; Salminen, 2018). To achieve sufficiently coherent teaching and learning practices and equal opportunities to learn for pupils across the country, the national core curriculum needs to provide a clear and aligned foundation for local development work. However, little is known about how educational stakeholders perceive the curriculum's coherence and whether coherent understanding of the curriculum can facilitate school development. This study complements the national curriculum literature by focusing on curriculum coherence in the context of the most recent reform in 2014.

In this study, the coherence making in curriculum reform is explored by examining how educational stakeholders make sense of the reformed core curriculum as a tool for the system-wide school development. Curriculum coherence has previously been studied mostly in terms of structural alignment or sequencing of content, or in terms of alignment between the intended, enacted and assessed curriculum (e.g. Fortus, Sutherland Adams, Krajcik & Reiser, 2015; Schmidt, Wang & McKnight, 2005; Squires, 2009). It has been shown to be related to pupil achievement and in addition, coherence has broadly been suggested as being an important factor in school improvement (e.g. Fullan, 1996; Fullan, 2007; Fullan & Quinn, 2016; Newmann, Smith, Allensworth & Bryk, 2001). Yet, there is a gap in research on the perceived curriculum coherence by educational stakeholders, particularly in the context of large-scale curriculum reform. Thus, this dissertation contributes to the literature by examining curriculum coherence as a subjective attribute from the perspective of those who matter most in school development – educational stakeholders involved in the curriculum reform process. Moreover, the study draws on various conceptualizations of coherence that have previously been suggested to facilitate learning and school development, in providing a model of perceived curriculum coherence.

Accordingly, the aim in this dissertation is to shed light on perceived curriculum coherence by examining its anatomy and by exploring how the various stakeholders involved in the Finnish curriculum reform process, including state- and district-level stakeholders and teachers, have perceived coherence of the latest core curriculum that was published in 2014. It is also examined whether the experienced curriculum coherence is related to the expected school impact of the curriculum reform process. The quantitative research design included data collected from three participant cohorts in accordance with the progress of the reform: from the state-level working groups while constructing the national core curriculum, from district-level stakeholders while they were involved in local curriculum development, and from teachers at two time points during the early stages of implementing the curriculum in classrooms. Both variable-centered and person-centered methodological approaches were utilised in order to gain information on individual and collective coherence making. In sum, this

dissertation contributes to the literature on curriculum reform by a) examining the anatomy of curriculum coherence and introducing an instrument for measuring it from the perspective of educational stakeholders, b) suggesting curriculum coherence as an important factor that contributes to school development, c) providing a systemic examination of various stakeholders' perceptions of curriculum coherence throughout a large-scale reform process, and d) combining variable-centered and person-centered methodological approaches in order to gain a comprehensive understanding on perceived curriculum coherence.

1.1 Curriculum reform

Curriculum functions as an overall rationale and plan for school practice, composing a framework for the purpose, substance and practice of teaching and learning (Foshay, 2000; Kelly, 2009). The curriculum is both an administrative document and a pedagogical instrument for teachers (Vitikka, 2009). The curriculum can be examined as the formal written curriculum or the functional implemented curriculum (Kelly, 2009). This study examines the national core curriculum, i.e. the formal curriculum document, while focusing on the *perceived* curriculum by state- and district-level stakeholders and teachers (hereafter referred to as educational stakeholders) and thus, can be seen to involve both the intended and implemented curriculum (see van den Akker, 2003). The curriculum is not a static document, but is dynamic and continously reconstructed and enacted in the everyday school practice (Ben-Peretz, 1990). The relationship between the curriculum and the practice of teaching and learning is complex and interactive (Ben-Peretz, 1990; Remillard, 2005). Accordingly, the dissertation concerns the policy-practice connection (e.g. Short, 2008), however, with an emphasis on local development and enactment rather than fidelity. It draws primarily on the literature on curriculum development and reform (see Connelly & Xu, 2010; Kelly, 2009) and curriculum implementation (see Fullan, 2008; Snyder, Bolin, & Zumwalt, 1992). It explores the issue of curriculum coherence as perceived rather than from a purely theoretical account, while taking into account the contextual frame of the three levels of the unique curriculum system in Finland. The dissertation represents empirically-grounded, contextualized and pragmatically-oriented curriculum research (Connelly & Xu, 2010).

The curriculum can be seen both as an object and an instrument of change (Atjonen, 1993). It serves the needs and demands of society by defining the knowledge to be learned by all pupils (Kelly, 2009). Changes in society and its values create new demands for education and pupils' learning outcomes, thus creating a need for curriculum change (Foshay, 2000; Kelly, 2009; Letschert & Kessels, 2003; Luttenberg, Carpay & Veugelers, 2013; Malinen, 1992; Reigeluth, 1994; Vitikka, 2009). Moreover, as research-based knowledge on teaching and learning develops, the theoretical understanding needs to be adapted in schools to

develop the quality of teaching and learning in practice (Kelly, 2009). Education provides a central means to facilitate social, cultural and economic wellbeing. Thus, reforming and updating the curriculum is crucial to educate the pupils better for the changing future (Darling-Hammond, 1998; Kelly, 2009; Luttenberg, Carpay & Veugelers, 2013; Malinen, 1992). *Curriculum reform* is considered here to be a collective learning process the aim of which is to develop the values, principles and practices of teaching and learning in school, such as objectives, subject matter, teaching methods, assessment principles (e.g. Snyder et al., 1992), or often in a large-scale systemwide change, all of the above.

Although demands and aims of curriculum reform evolve with the broader societal development, implementing a curriculum reform is not a straightforward process. *Curriculum implementation* refers to the enactment of the curriculum by schools and teachers and involves the continous process of co-construction and adaptation of the curriculum at the school-level (Coburn, 2003; Fullan & Pomfret, 1977), such as translating the changes and principles of the national core curriculum in Finland to local curricula and finally into classroom practice. Hence, implementation is considered here to involve continuous negotiation and adaptation between the teacher and the curriculum in order to develop pedagogical practices that create coherence in pupils' learning experiences (see also Lindvall & Ryve, 2019; Remillard, 2005). However, there is often a gap between policy intentions and school practice and it has been shown that educational innovations are not easily transformed into large-scale reforms (e.g. Fullan & Pomfret, 1977; Snyder et al., 1992; Spillane, 1999; van den Akker, 2003). Moreover, the core practices of teaching and learning have been shown to be difficult to change (e.g. Elmore, 1996; Tyack & Cuban, 1995).

Many factors that relate to the success of curriculum reform have been identified. What happens in schools has been shown to depend on school-level knowledge, beliefs, norms, leadership and motivational factors more than on the views of policymakers (see Darling-Hammond, 1998). Reform strategies have been criticised for decreasing teacher professionalism, focusing on the innovation instead of the process, expecting the change to happen in an unrealistic time without sufficient resources, and thus being difficult to implement in the everyday life of schools (e.g. Fullan, 2007; Fullan & Pomfret, 1977; Tyack & Cuban, 1995). On the other hand, school-based development has rarely succeeded in helping schools of different capacities equally, or spreading into large-scale changes at a national level, for instance (Darling-Hammond et al., 2006; Elmore, 1996; Fullan, 2007; Morris, 2000; Smith & O'Day, 1991).

To resolve challenges identified with reform complexity, it has been suggested that coherence within the curriculum and between the curriculum reform and school practice is crucial (e.g. Luttenberg, Carpay & Veugelers, 2013). Thus, the curriculum should provide an aligned and clear foundation based on which educational practitioners can make sense of the reform, transforming it into local

school and classroom practice. In contrast, fragmentation and contradictions in the educational policy system, teacher training, professional development and curriculum have been recognized as barriers to large-scale school development (e.g. Smith & O'Day, 1991; van den Akker, 2003). Two common approaches in the literature on resolving problems faced in curriculum reform have been identified: the innovation perspective and the implementation perspective (Knapp, 1997). The innovation perspective has emphasized the design and dissemination of effective policies or reforms, while the implementation perspective has focused on exploring the ways that policies are interpreted, redefined and interact with context throughout the educational system (Knapp, 1997). The aim in this study considers both perspectives, by examining curriculum coherence, a characteristic of the innovation (the reformed national core curriculum document), as perceived by various stakeholders in the ongoing curriculum reform and implementation process in the state, district and school levels.

1.2 Curriculum coherence

Curriculum coherence refers to connectedness and unity within the curriculum's purpose, substance and practice (Beane, 1995; Foshay, 2000). It is suggested that curriculum coherence will facilitate pupil learning directly as well as through supporting teachers in school development (Newmann et al., 2001). For instance, it has been suggested that coordination and sequencing of topics across subjects and grades are crucial for pupils to develop a deep and integrated understanding of a topic in science education (e.g. Fortus & Krajcik, 2012; Shwartz, Weizman, Fortus, Krajcik & Reiser, 2008). Similarly, curriculum coherence is needed in order for the educational stakeholders, particularly teachers, to develop a coherent understanding of a curriculum's purpose, goals and consequences in a reform context. Through teacher learning and aligned pedagogical practices triggered by the curriculum reform, a coherent curriculum may eventually lead to more coherent learning experiences for pupils (see Ferrini-Mundy, Burrill & Schmidt, 2007; Newmann et al., 2001).

Coherence can be considered to be a subjective (perceived) or actual (objective or structural) attribute of the curriculum document (see Century & Cassata, 2016; Desimone, 2006; Honig & Hatch, 2004; Remillard, 2005). It has been suggested that policies should be aligned in a structural, i.e. actual, sense in order to promote systemic school improvement (see e.g. Martone & Sireci, 2009; Smith & O'Day, 1991). Accordingly, some of the research on curriculum coherence has focused on analysing the sequencing, pacing and continuity of content and other elements within curriculum or subject content (e.g. Fortus et al., 2015; Schmidt et al., 2005). Alignment between standards or goals, content, assessment and/or learning materials has been extensively studied at the level of policies, policy systems and within curriculum (e.g. Martone & Sireci, 2009; Squires, 2009; Webb, 1999). On

the other hand, coherence in practice is also dependent on the subjective or perceived curriculum coherence, i.e. on the interpretations of the curriculum by the local districts, schools, and teachers (see Beane, 1995; Honig & Hatch, 2004).

The curriculum perceived by teachers is suggested to matter more for school development than actual coherence within the written curriculum (see Desimone, 2006; Fullan, 1996; Kohonen, 2001). For instance, teachers' perceptions of coherence depend also on the fit with local goals and pupils' needs (Penuel, Fishman, Yamaguchi & Gallagher, 2007). Coherent perceptions of professional development programmes have been shown to be connected to changes in teachers' knowledge and practice and to program implementation (Penuel et al., 2007), yet to vary between individuals (Allen & Penuel, 2015). Hence, perceived coherence seems to be an important determinant of meaningful teacher learning in a reform context. Policy coherence has also been seen as depending on implementation at the local level where practitioners "craft coherence" from various policy messages to integrate them into local goals and practice (Honig & Hatch, 2004; Stosich, 2018). Thus, coherence is a dynamic process, requiring continous effort of negotiation and adjustment (see also Canrinus, Bergem, Klette & Hammerness, 2017; Fullan & Quinn, 2016; Hammerness, 2006; Honig & Hatch, 2004) throughout the educational system and between the different operating levels in terms of developing schools (i.e. state-, district- and school levels).

The actual coherence within the curriculum document and subjective coherence as perceived by educational stakeholders can also be interrelated (Kohonen, 2001; Russell & Bray, 2013; Spillane & Callahan, 2000; Spillane, Reiser & Reimer, 2002) as better aligned and consistent policies may more easily facilitate coherent perceptions of educational stakeholders and further, coherence in practice (Russell & Bray, 2013). For instance, it is assumed that teachers are more likely to change their practice according to a reform if curriculum, materials, training and tests are aligned, and effort has been invested in designing these elements to cohere better with each other (Knapp, 1997; Russell & Bray, 2013). Moreover, the actual coherence of the curriculum document might reflect the extent to which the curriculum developers have reached a shared and coherent view of the main principles of the curriculum.

Although the importance of perceived or subjective coherence has been called after, empirical research on curriculum coherence as a subjective characteristic is scarce. Some studies have focused on school-level coherence of the instructional program (Newmann et al., 2001), while others have examined perceived coherence specifically in the context of professional development programs (Allen & Penuel, 2015; Penuel et al., 2007; Penuel, Fishman, Gallagher, Korbak & Lopez-Prado, 2009). Yet, curriculum coherence has been studied mostly at the policy level (Schmidt & Houang, 2012; Schmidt et al., 2005), or within a specific subject (e.g. Fortus et al., 2015; Shwartz et al., 2008) as a structural attribute of

the curriculum. Coherence has also been studied in teacher education programmes in terms of both structural alignment and perceived characteristic (see e.g. Grossman, Hammerness, McDonald & Ronfeldt, 2008; Hammerness, 2006). Accordingly, conceptualizations of coherence are various (see also Lindvall & Ryve, 2019; Newmann et al., 2001). However, there seems to be a gap in the literature on perceived, i.e. subjective, curriculum coherence by educational stakeholders in large-scale curriculum reform in basic education.

In this dissertation, perceived curriculum coherence has been examined through three elements, contextualised in the most recent national curriculum reform in Finland. The elements cover various dimensions of coherence that have been shown to be central in curriculum reforms. Firstly, the *consistency of the intended direction* refers to promoting a shared direction that clarifies the goals of schools and supports the teaching of essential substance. This element is crucial for coherence in order to establish a clear long-term purpose towards which all of the curriculum's elements are directed at. Secondly, an *integrative approach to teaching and learning* focuses on providing a holistic approach to teaching and learning that encourages activating and engaging teaching. This is another core element of coherence that promotes holistic and integrated learning experiences that connect to a larger whole. Thirdly, *alignment between objectives, content and assessment* is characterised by connectedness and continuity within the curriculum. This final element is essential for coherence as it creates connections between what is intended, taught and assessed, as well as promotes the continuity of learning through subjects and grades.

1.2.1 Consistency of the intended direction

Consistency of the intended direction refers to the curriculum's role in establishing coherent and clear direction that facilitates and guides relevant local school development and practice. It implies a long-term purpose, in contrast to rapidly changing policies, fragmented reform efforts, and innovation overload (Morris, Lo, Adamson, 2000; van den Akker, 2003). Thus, the consistent direction as an element of curriculum coherence promotes the construction of shared understanding of the long-term goals of the curriculum by educational stakeholders at all levels of the system, which is crucial for school development (Datnow & Stringfield, 2000; Fitzpatrick, 1995; Hallinger & Heck, 2002; Lasky et al., 2005).

Agreement on the direction of the curriculum means that the stakeholders understand the purpose and see the direction as relevant and worth aiming towards (Cheung & Wong, 2011; Smith & O'Day, 1991). In other words, the direction of the curriculum should be seen to drive school development towards outcomes desired by educational stakeholders, for instance, clarifying the mission of teachers and schools, and supporting the teaching of what is perceived to be

important for pupils. Perceiving the reform goals as holistic has been shown to be related to teachers' sense of ownership over the reform implementation (Pyhältö, Pietarinen & Soini, 2012, 2014). In contrast, lack of explicitness or clarity and contradictory messages about the reform may cause uncertainty and confusion among schools and teachers and lead to superficial or unintended changes (Allen & Penuel, 2015; Boesen et al., 2014; Choi & Walker, 2018; Fullan & Pomfret, 1977; Ketelaar, Beijaard, Boshuizen & Den Brok, 2012; Morris et al., 2000; Priestley, Minty & Eager, 2014; Russell & Bray, 2013; Shaked & Schechter, 2018; Smith & Southerland, 2007).

Systemic school reform initiatives have emphasized the importance of sufficient understanding, agreement and commitment among key stakeholders at the various levels of the educational system (Adelman & Taylor, 2007; Chrispeels & González, 2006; Desimone, 2013; Senge, 1990). Focus and coherence in terms of goals and an underlying rationale contribute to a shared direction that provides coherence and unifies the curriculum reform throughout the educational system (e.g. Adelman & Taylor, 2007; Confrey, Castro-Filho & Wilhelm, 2000; Smith & Smith, 2009). Often contradictory demands are placed on schools by the broader community (Honig & Hatch, 2004) and thus, a consistent direction that helps to delimit the work of teachers and schools and to identify the core aims and purpose of schools is necessary to facilitate reform ownership (Chrispeels & González, 2006). For instance, shared ownership of clear goals has been shown to be essential for organizational improvement (Allison & Kaye, 2015; Bryson, 1995; Senge, 1990). A shared vision has also been shown to facilitate school effectiveness (Purkey & Smith, 1983), improvement culture (Reezigt & Creemers, 2005), long-term commitment (Senge, 1990) and better coping with reform implementation (Louis & Miles, 1991). Moreover, it has been shown that successful school leadership involves building a shared vision (Geijsel, Sleegers, van den Berg & Kelchtermans, 2001; Hallinger, Bickman & Davis, 1996; Leithwood, Harris & Hopkins, 2008; Sleegers, Thoonen, Oort & Peetsma, 2014) and that developing schools have a sense of shared purpose (Hallinger & Heck, 2002; Newmann et al., 2001; Priestley et al., 2014; Reezigt & Creemers, 2005).

Clear direction and purpose allow schools to focus on goals that are seen as the most important (Purkey & Smith, 1983; Reezigt & Creemers, 2005; Senge, 1990). The direction, however, needs to be co-constructed and adaptable in the various conditions of the reform to support the fit with personal goals and to facilitate commitment to the aimed direction (Fullan, 1993; Kohonen, 2001; Sleegers et al., 2014). Thus, coherence should involve flexibility for local variation and continous improvement (Beane, 1995; Buchmann & Floden, 1992; Smith & Smith, 2009). Hence, consistency of the intended direction does not imply that the curriculum should be implemented as the same in every context; in fact, space and support for local adaptation and variation is crucial.

1.2.2 Integrative approach to teaching and learning

An integrative approach to the development of teaching and learning as an element of curriculum coherence refers to supporting integrative instruction and providing a coherent system of instructional guidance (Cohen & Spillane, 1993; Darling-Hammond et al., 2006; Newmann et al., 2001; Smith & O'Day, 1991). Curriculum reform is always situated in certain cultural, political and historical contexts (Levin, 2001), and the integrative approach to teaching and learning can be considered to be a more context-specific element of curriculum coherence than the other two elements. The Finnish educational system has generally emphasized the development of teaching and learning in a holistic way and has encouraged different forms of curriculum integration (Niemelä & Tirri, 2018; Vitikka, 2009). The general aims and principles of the core curriculum (FNBE, 2014) reflect an integrative approach by emphasizing a holistic, pupil-centered approach to teaching and learning, integration of subjects and content (see also Geraedts, Boersma & Eijkelhof, 2006; Klein, 2002), and assessment that aims to support pupil learning (see also Guskey, 2003) as ways to promote coherent teaching and learning practices.

Thus, the integrative approach to teaching and learning relates to the organization of what is taught by harmonizing teaching, i.e. fostering integration and holistic learning experiences (Atjonen, 1993). This concerns building *horizontal* coherence between curriculum content and experiences (see e.g. Koskenniemi & Hälinen, 1970; Vitikka, 2009). The harmonization of teaching, using activating and engaging teaching methods, and encouraging the use of assessment to support learning also imply that teaching and learning are aimed towards understanding (Darling-Hammond, 1998). It has also been proposed that activating and engaging teaching is part of effective teaching (see e.g. Creemers & Kyriakides, 2008; Kyriakides, Creemers & Antoniou, 2009; Maulana, Helms-Lorenz & van de Grift, 2017; van de Grift, 2007). However, the type of instructional practices and methods that are related to active participation, engagement and building deep understanding often require new skills, capacity, strategies and practices from the school system and teachers (Darling-Hammond, 1998; Drake & Miller, 2001). Especially integration between subjects and content requires new forms of collaboration within the teaching community (Kysilka, 1998; Niemelä & Tirri, 2018). Thus, school-level capacity building, shared understanding of and commitment to the principles and goals of teaching and learning, and support for the new practices at the local level are necessary if they are to have an impact on the core of school practice (Darling-Hammond, 1998; McLaughlin, 1998).

The integrative approach to teaching and learning is important in curriculum change because focusing on developing the core issues of teaching and learning promotes a reform process that takes into account school practice, anticipates and prepares for the effects and challenges at the school-level and is thus more likely

to be adaptable and perceived as worthwhile in the school practice (Coburn, 2003; Darling-Hammond, 1998; Elmore, 1996). Focusing on the core practices of teaching and learning might involve changing teachers' understanding about the nature of knowledge and subject matter, about how their pupils learn, and constructing an understanding on how these issues connect to and affect their teaching practice (Coburn, 2003; Elmore, 1996). The promoted approach to teaching and learning should be in line with the other parts of the curriculum renewal, such as selecting key subject content and ways of assessing pupils' progress, in order to facilitate coherence at the system level (see also van den Akker, 2003; Vitikka, 2009). This is connected to the alignment element of curriculum coherence.

1.2.3 Alignment between objectives, content and assessment

It has been proposed that alignment between the components of the curriculum, such as objectives, content, instructional methods, learning activities, materials and assessment, is a crucial factor for an effective curriculum and for the unity and meaningfulness of pupils' learning experiences (Anderson, 2002; Cohen, 1987; Fitzpatrick, 1995; Roach, Niebling & Kurz, 2008; Squires, 2009; Tyler, 1949; van den Akker, 2003; Webb, 1997). For instance, the development of pedagogy requires that the assessment practices are developed in alignment with it to support the intended ways of teaching and learning (Morris et al., 2000). Alignment is contrasted with contradiction and fragmentation within the curriculum and educational system (Roach et al., 2008; Russell & Bray, 2013; Webb, 1997). Moreover, in this study, alignment is considered to include the continuity within subjects and across grades. Thus, alignment refers here to how the objectives, content, instructional methods and assessment cohere and acknowledge the pupils' age range while learning is built across subjects and grades, aiming at higher levels of understanding (see Fortus & Krajcik, 2012; Fortus et al., 2015; Newmann et al., 2001; Schmidt et al., 2005; Shwartz et al., 2008; Webb, 1997). Continuity and sequencing through units, subjects and grades has also been refered to as the *vertical* coherence within curriculum (see e.g. Koskenniemi & Hälinen, 1970; Vitikka, 2009).

Alignment between objectives, standards, instruction and assessment at the system and curriculum level have been shown to improve pupil achievement (Kurz, Elliott, Wehby & Smithson, 2010; Squires, 2009, 2012). Moreover, the sequencing and progression of content within and across units and grades is connected to pupil achievement and deep learning in mathematics and science (e.g. Fortus et al., 2015; Schmidt & Houang, 2012; Schmidt et al., 2005; Shwartz et al., 2008). Constructive alignment, i.e. aligning intended learning outcomes, learning activities and assessment tasks, has also been shown to be an important

determinant of high quality teaching and effective learning in higher education (e.g. Biggs & Tang, 2011; McMahon & Thakore, 2006).

The aim of most alignment research has been to evaluate the degree of alignment with different methods (e.g. Porter, 2002; Roach et al., 2008; Webb, 1997; Webb, 1999) and some of the methods also include surveys to collect information on instructional content (Martone & Sireci, 2009). However, it has been suggested that more important than aiming to align the components of the policy system is to achieve subjective coherence at the local level (see also Fullan, 1996; Luttenberg, van Veen & Imants, 2013), hence focusing on how the curriculum users interpret alignment in relation to practice. A few studies on teachers' perceptions of coherence and alignment within professional development have also suggested that the coherence experienced by teachers is more important for reform implementation than alignment at the policy level (e.g. Allen & Penuel, 2015; Penuel et al., 2009). Yet, research on perceived alignment in curriculum reform is scarce.

Like any of the elements of curriculum coherence, alignment within and between the components of the curriculum alone is not sufficient to guarantee coherent perceptions about the curriculum, meaningful teaching and learning activities or coherence at school level (see also Penuel et al., 2009). A curriculum can be perceived to be aligned even though it decreases the quality of learning or shifts the focus to unessential content that lack meaning for teachers and pupils (see also Beane, 1995). Hence, coherence also entails the quality of the aligned elements: an explicit purpose that the educational stakeholders agree with, and an integrative framework for the development of teaching and learning. Curriculum coherence requires that the aligned elements of the curriculum consistently support and clarify the work of teachers and schools.

Thus, it is proposed that the three elements of curriculum coherence are complementary. Alignment between objectives, teaching methods, content and assessment, as well as progression in subjects and grades, creates continuity and coherence *within* each learning unit and subject. In addition to this, an integrative approach to teaching and learning is needed to facilitate learning through which pupils actively create linkages and bridges *between* subjects and learning units, aiming for holistic understanding of complex entities. Finally, as an overarching direction for the development of these elements, consistency in the intended direction of the curriculum provides a coherent purpose that is functional and meaningful for school practice.

1.3 Coherence making in large-scale curriculum reform

Curriculum coherence requires coherence making – that educational stakeholders construct a shared and coherent understanding of the meaning and effects of the curriculum in terms of the three elements: consistency of the intended direction;

integrative approach to teaching and learning; and alignment between objectives, content and assessment. In this study, coherence making is considered to take place through sensemaking, thus examining how various educational stakeholders interpret the curriculum. *Sensemaking* entails constructing meaning and an interpretation of the curriculum reform, its aims and demands, in relation to existing beliefs, experiences, motivation, practice and resources (Allen & Penuel, 2015; Century & Cassata, 2016; Ganon-Shilon & Schechter, 2018; Gawlik, 2015; Luttenberg, van Veen & Imants, 2013; März & Kelchtermans, 2013; Spillane et al., 2002; Weick, 1995). It occurs throughout the complex and interactive levels of the educational system (Datnow & Park, 2009; Fullan, 2007). From this point of view, *coherence making* refers to the process of building coherent understandings of the object of change through sensemaking activities. While crafting coherence has been studied in terms of how educational practitioners make sense of multiple external demands at the school-level (e.g. Honig & Hatch, 2004; Russell & Bray, 2013), coherence making involves aligning individual and collective development towards shared goals (Fullan, 2000). More specifically, in this study coherence making is considered to be focusing on the three elements of curriculum coherence within the written curriculum in the context of large-scale curriculum reform. Coherence making is here understood as a continous process that is influenced by the curriculum, the educational stakeholders and their experiences and beliefs, and the context (Russell & Bray, 2013; Spillane et al., 2002). The process of coherence making is situated at the levels of the individual, the collective (such as the professional community), and the institutional context.

Firstly, the individual teacher or stakeholder plays an important role in coherence making, because the individual's prior beliefs, values, norms and experiences in professional practice interact in the sensemaking process concerning the curriculum (Century & Cassata, 2016; Donnell & Gettinger, 2015; Spillane, 1999; Spillane et al., 2002). Classroom practices are to a great extent determined by the individual teacher and thus, the teacher has an essential role in curriculum enactment (Kelly, 2009; Salminen & Annevirta, 2016). For instance, a teacher's understanding of the structure and connections within subjects and curriculum influence coherence in classroom practice (Ferrini-Mundy et al., 2007). Moreover, teachers' evaluation of the fit between their interpretation of the curriculum and their experience in the classroom practice is crucial for implementation (e.g. Coburn, 2004; Luttenberg, van Veen & Imants, 2013). In addition to teachers, individual stakeholders at the national and local levels may have an important role in facilitating and mediating reform efforts according to their own understandings and beliefs. For instance, a school leader has a significant role in establishing the culture for coherent change in a school (Coburn, 2005; Louis & Robinson, 2012).

Studies in educational reform have shown that individuals often differ in terms of how they understand curriculum reforms and what the reform requires them to

change, how the reforms affect them, and how they learn and make sense of the intended changes (e.g. Bakkenes, Vermunt & Wubbels, 2010; Desimone, 2013; Ganon-Shilon & Schechter, 2018; Gawlik, 2015; Ketelaar et al., 2012; Knapp, 1997; Luttenberg, van Veen & Imants, 2013; März & Kelchtermans, 2013; O'Sullivan, Carroll & Cavanagh, 2008; Spillane, 1999). Fundamental change, i.e. grasping the full idea of the reform and internalising and transforming it into practice in a coherent way, is not easy or fast (Boesen et al., 2014; Cohen & Hill, 2000; Gregoire, 2003). Usually, the easily adoptable aspects of reform and ideas that fit well with stakeholders' and teachers' existing beliefs and practice are more often implemented (e.g. Berman & McLaughlin, 1976; Coburn, 2005; Donnell & Gettinger, 2015; Knapp, 1997; Manouchehri & Goodman, 1998; Spillane & Callahan, 2000). Experiences of cognitive or emotional dissonance and ambiguity often occur in the sensemaking process (Choi & Walker, 2018; Kohonen, 2001). However, incoherence can also function as a driver for developing new understanding (see Gregoire, 2003). In addition, it has been shown that teachers differ in terms of how they engage in sensemaking efforts in professional development, and how they cope with incoherence (Allen & Penuel, 2015). Thus, if the curriculum reform is perceived as incoherent with other policies or one's beliefs and values about teaching and learning, the individual might ignore the reform altogether, assimilate the changes to the existing beliefs, or transform and create new beliefs that add coherence within the reform (see Gregoire, 2003; Ketelaar et al., 2012; Russell & Bray, 2013).

It has been suggested that involvement in the reform design and experience with curriculum development contribute to individuals' ownership of the reform (Atjonen, 1993; Voogt, Pieters & Handelzalts, 2016) and that sufficient knowledge and understanding of the curriculum and the reform's aims is a prerequisite for implementation (Ng, 2009). Yet, knowledge of the curriculum is not a sufficient precondition for coherent understanding (see Spillane, 1999). Teachers' deep understanding of the curriculum reform may in some case increase stress and decrease self-efficacy if the demands of the change are perceived as being too challenging relative to the capacities and resources, thus anticipating difficulties in the implementation (McCormick, Ayres & Beechey, 2006). Thus, deep *and* coherent understanding of the object of change is assumed to facilitate the change process. However, based on the variation found in the research on reform implementation, various paths for coherence making by individuals in the reform context are expected to occur.

Secondly, the social context, such as professional communities at the school or district level, shape coherence making. Constructing a coherent understanding of the curriculum is both an individual and collective process. Individuals interpret the curriculum in interaction while discussing and negotiating with colleagues, in interaction with pupils in the classroom practice, and with other stakeholders involved in the curriculum development (see Louis, Febey & Schroeder, 2005;

Spillane, 1999). Patterns of collective sense-making (Weick, 1995) and constructing shared understanding in local professional communities have been suggested being as a crucial part of reform interpretation (Butler, Schnellert & MacNeil, 2015; Coburn, 2001; Louis et al., 2005; März & Kelchtermans, 2013; Soini, Pietarinen & Pyhältö, 2018; Spillane, 1999). For instance, it has been suggested that collaboration and negotiation with colleagues are an important determinant in turning experienced incoherence into learning and adaptation of the reform into local practice (Allen & Penuel, 2015). Moreover, educational stakeholders may rely on information and interpretations received from others, such as colleagues or educational leaders from various levels (Allen & Penuel, 2015; Coburn, 2001, 2005; Manouchehri & Goodman, 1998). The ways in which the reform is interpreted and further presented by administrative actors, districts, municipalities and schools, influences the stakeholders and practitioners at the next level, shaping their possible impressions, attitudes, knowledge, skills and willingness to implement the reform (Coburn, 2005; Darling-Hammond, 1998; Darling-Hammond et al., 2006; Ganon-Shilon & Schechter, 2018; Gawlik, 2015; Lasky et al., 2005; Morris, 2000). For instance, leaders may influence teachers' curriculum interpretation by shaping their opportunities to learn, access to and focus of policy messages (Coburn, 2001, 2005; Coburn & Russell, 2008; Gawlik, 2015). Thus, it can be argued that coherence making is mediated through the educational system by different stakeholders' sensemaking and further facilitation of coherence making for others. If a district-level administrator or a school leader has contradictory, insufficient or superficial perceptions of the curriculum reform, they are less likely to mediate the reform message coherently to schools and teachers and to provide opportunities for coherent curriculum development that would promote enactment of the curriculum as intended (see also Coburn, 2005; Spillane & Callahan, 2000).

Thirdly, coherence making is situated in the institutional context, which determines structural and cultural conditions such as roles, responsibilities and norms that have been shown to influence the ways that stakeholders make sense of curriculum reform (see Darling-Hammond et al., 2006; Datnow & Stringfield, 2000; Fernandez, Ritchie & Barker, 2008; Priestley, 2011; Russell & Bray, 2013; Senge, 1990; Spillane et al., 2002). At each level of the educational system, the context influences the processes of sensemaking and interaction, which in turn may mediate as conditions for the next levels (Lasky et al., 2005). In particular, the local organisation and its contextual factors have been identified as influencers of individual and collective sensemaking (Louis et al., 2005; Manouchehri & Goodman, 1998; März & Kelchtermans, 2013; Spillane, Gomez & Mesler, 2009). Thus, coherence making might vary between *and* within the various levels of the educational system. Accordingly, variation between stakeholder groups at different levels of the educational system, such as curriculum designers, administrators, principals and teachers, has often been shown to occur in terms of

how they perceive, understand and respond to reforms (e.g. Desimone, 2006; Ng, 2009; Spillane, 1998; Timperley & Parr, 2005; Wong & Cheung, 2009). Yet, some consensus about the aims, meaning and effects of a curriculum throughout the educational system has been proposed as being key to promoting school-level ownership and implementation in the case of large-scale curriculum reform (see Fullan, 2007; Lasky et al., 2005; Ng, 2009; Timperley & Parr, 2005).

Curriculum development requires continous coherence making at all levels of the system, yet, the emphasis and challenges may vary between the levels (van den Akker, 2003). This variability in emphasis is adaptive as long as the stakeholders have a sufficiently coherent and deep understanding of the curriculum's main pinciples and purpose (see Coburn, 2003). In general, the role of the state-level policymakers and administrators focuses on navigating between the interests of various actors and stakeholder groups and facilitating shared goals in the educational system (Letschert & Kessels, 2003; Smith & O'Day, 1991). Thus, in the state-level development process, coherence making might emphasize establishing a consistent direction for the curriculum. In turn, stakeholders at the district level play a key mediating role between the national and school level (Lasky et al., 2005; Louis et al., 2005; Spillane, 1996; Sykes, O'Day & Ford, 2009). They interpret the state-level policies and goals, at best transforming them into more close alignment with the local context, while guiding and supporting school-level development by providing resources to meet the goals (Chrispeels & González, 2006; Morris, 2000; Spillane, 1998). Yet, the district-level stakeholders may differ in how they interpret the reform themselves, and how willing and capable they are in supporting the implementation of the reform further at the schools in the district (Cantlon, Rushcamp & Freeman, 1990; Datnow & Stringfield, 2000; Desimone, 2006; Dutro, Fisk, Koch, Roop & Wixson, 2002; Knapp, 1997; Spillane, 1996; Spillane et al., 2002). Finally, at the school level, activities of coherence making involve interpreting the curriculum and reform messages from the national and district levels, and transforming the curriculum into practice while focusing on how best to suit the needs of pupils (see Fernandez et al., 2008; Ganon-Shilon & Schechter, 2018; Newmann et al., 2001; Russell & Bray, 2013). Here, the coherence making process might emphasize building alignment and fit between the local adaptations and the practices, materials and resources for teaching and learning (see also van den Akker, 2003).

In sum, individual and collective coherence making within and between the levels of the educational system is assumed to promote opportunities for meaningful school development. However, individual and collective coherence making takes time. Educational stakeholders' understanding of the curriculum has been shown to vary over time. It can evolve while individuals and professional communities move from initial impressions towards deeper understandings, clarify the consequences of the reform in their everyday work, gain more skills and capacities, experience with the curriculum and reflect on the changes and

success of their experimentations (Bakkenes et al., 2010; Coburn, 2004; Drake & Miller, 2001; Fullan, 1993; Lo, 2000; Luttenberg, van Veen & Imants, 2013; Remillard, 2005; Sahlberg, 1996; Spillane et al., 2002; Wong & Cheung, 2009). For instance, teachers may initially show little readiness to change but increase their estimation of the reform's importance during implementation (Bliss & Wanless, 2018). This implies that educational stakeholders' experienced curriculum coherence might vary not only between and within the levels of the educational system, but also over time.

1.4 School impact of curriculum reform

Eventually the aim of most curriculum reforms is to improve pupil learning and overall positive development, such as to increase pupils' engagement, achievement and well-being in schools. However, promoting meaningful learning also requires fit between the coherent, aligned curriculum and schools' and teachers' capacity to adopt new transformative pedagogical practices in the local context of the school. In addition to perceiving the curriculum as coherent, educational stakeholders need to experience the reform to fit their own goals and practice (Luttenberg, van Veen & Imants, 2013; Penuel et al., 2007), for instance solving challenges that they have faced in their work (see Snyder et al., 1992). This can be addressed by examining how they perceive the reform's impact on schools.

Various studies have shown that curriculum reform, at its best, can achieve changes in teachers' epistemological beliefs and professional understanding and promote functional changes in teaching and learning, such as in classroom interaction and learning activities implemented by teachers (e.g. Bakkenes et al., 2010; Cheung & Wong, 2011; Chrispeels & González, 2006; Desimone, 2013; Ketelaar et al., 2012; Kohonen, 2001; Li & Ni, 2011). On the other hand, there is evidence of little impact or assimilation of reform in school-level practice (e.g. Boesen et al., 2014; Fernandez et al., 2008; Tyack & Cuban, 1995). Moreover, the impact that curriculum reform has on schools might include partial implementation, mixture with old practice, positive and negative consequences, unintended effects, and might also affect areas that the reform was unintended to reach (Cohen, 1990; Cohen & Hill, 2000; Morris, 2000).

In this study, *school impact* of curriculum reform is understood as the extent to which the reform process facilitates sustainable and locally functional school development, for instance shifting reform ownership by committing teachers to maintain the development work, and directing the school-level development work towards solving local challenges (Coburn, 2003; Fullan, 2007). This kind of sustainable school development requires a continuous process of facilitating ownership on the part of those involved (Coburn, 2003; Pyhältö et al., 2014; Sleegers et al., 2014) and local negotiations aiming to develop adaptable and

feasible pedagogical practices in the school. It also requires constructing shared understandings about the goals of the reform between different levels of the educational system (Datnow & Stringfield, 2000; Fullan, 2007; Sleegers et al., 2014). In contrast to measuring the impact of reform from a fidelity perspective (Century & Cassata, 2016; Snyder et al., 1992), this approach considers the processes of developing values, beliefs and norms as a way to develop school practice, emphasizing the focus on capacity for sustainable professional development as successful reform (see Coburn, 2003; Darling-Hammond, 1998; Fullan, 1996). In the end, the impact of a curriculum reform on school-level development depends on the interaction within and between the various levels of the educational system and their understanding of the reform (e.g. Cheung & Wong, 2011; Fernandez et al., 2008; Fullan, 2007; Timperley & Parr, 2005; Yuen, Cheung & Wong, 2012).

Educational stakeholders' interpretations of the curriculum and their intentions about changing practice are related to the impact of the curriculum reform on schools (see Cohen & Hill, 2000; Fullan, 2007; Louis et al., 2005; Penuel et al., 2007; Priestley et al., 2014; Yildirim & Kasapoglu, 2015; Yin, Lee & Jin, 2011). For instance, if educational stakeholders perceive the reform as a way to resolve problems they have faced in school-level practices, they will more likely find it adaptable and meaningful to their work (Berman & McLaughlin, 1976; März & Kelchtermans, 2013; Southerland, Sowell, Blanchard & Granger, 2011; Waugh & Godfrey, 1993; Wong & Cheung, 2009). In other words, teachers' and stakeholders' commitment is promoted by a reform that enables them to cope better with the various demands of the everyday life at schools. Previous studies have also suggested that teachers' understanding of and orientation towards the curriculum reform affects the development of their classroom practices and the enactment of the curriculum (e.g. Ketelaar et al., 2012; März & Kelchtermans, 2013; Ramberg, 2014; Spillane et al., 2002). Accordingly, in this dissertation it is proposed that the curriculum coherence that is perceived by educational stakeholders contributes to their expectations of locally functional and relevant school development. This may further promote the reform's impact on practice at the school level (see Allen & Penuel, 2015; Fullan, 1996; Newmann et al., 2001; Russell & Bray, 2013; Tan & Nashon, 2015).

1.5 Summary of the theoretical framework

Curriculum coherence, a construct that has previously been conceptualized and studied in various ways, is examined in this dissertation by drawing on elements that have been suggested as being crucial for school development and by focusing on the perspective of the educational stakeholders. Their view on the curriculum and the perceived curriculum coherence matters for school development, as local functionality and ownership of implementation requires the educational

stakeholders to have a coherent understanding of the curriculum in relation to their practice. In this dissertation, perceived curriculum coherence is hypothesized to include three complementary elements (Figure 1): 1) consistency of the intended direction, 2) an integrative approach to teaching and learning, and 3) alignment between objectives, content and assessment.
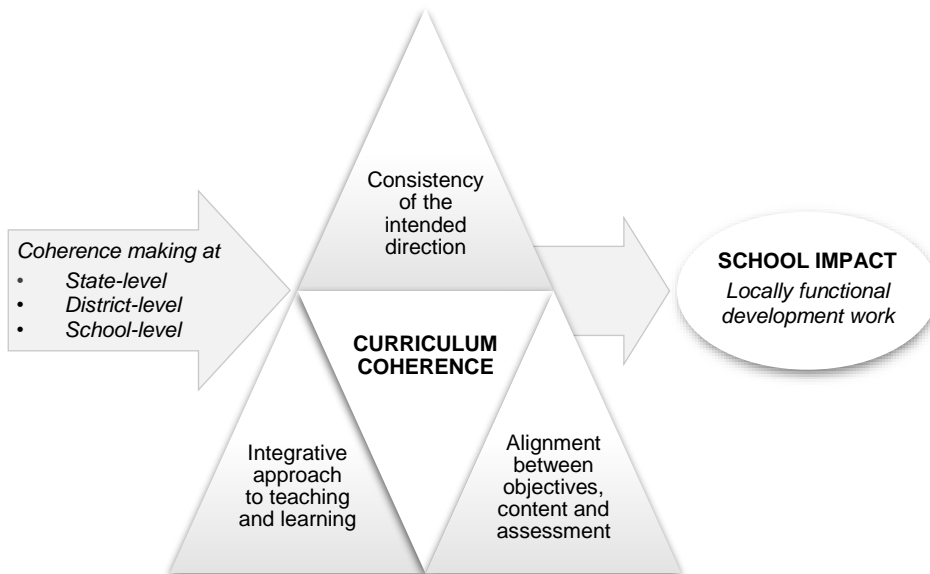
Figure 1. Summary of the theoretical framework.

It is suggested in this study that curriculum coherence as experienced by the various actors in the educational system facilitates coherence in their thoughts and actions about developing teaching and learning and thus, is connected to further school-level development. School-level impact of the reform, in terms of perceiving the reform as relevant and as a potential tool for transforming the local school practice to better serve the pupils, requires individual and collective efforts of coherence making. Coherence making, i.e. making sense of and negotiating the issues crucial to each element of curriculum coherence, is important throughout the levels of the educational system. It occurs in interaction with the contextual factors within and between the various levels of the educational system; individual, school, district, and state. In this dissertation, perceptions of curriculum coherence of the various educational stakeholders are considered to reflect the individual and collective processes of coherence making and how it has been mediated through the educational system in the process of the national curriculum reform. This study proposes that constructing coherence about what the new core curriculum means in terms of its purpose and content can support meaningful development at the school-level (Figure 1).

2 Curriculum reform in Finland

Curriculum reform reflects the educational system, policy and values of the societal context (Century & Cassata, 2016; Lasky et al., 2005). In Finland, school development is based on values such as quality, equity and trust (see Sahlberg, 2015). Moreover, human rights, cultural diversity, sustainability and a democratic, egalitarian society form the basis of the national core curriculum's goals (Finnish National Board of Education, 2014). Equal opportunities for all pupils to learn, regardless of location, background or school, has been a basic principle of the Finnish comprehensive school system (Vitikka, 2009). The educational system in Finland is also characterized by continuous development and long-term vision (Sahlberg, 2015).

2.1 The Finnish educational system

The Finnish basic education system is based on the Basic Education Act. The comprehensive school system, introduced at the beginning of the 1970s, provides basic education for children typically from the age of seven to sixteen, including primary school (grades 1-6) and lower-secondary school (grades 7-9). The government defines the general aims and subject hour distributions for schools (Halinen & Holappa, 2013). The Finnish National Agency for Education (FNAE, previously Finnish National Board of Education) is an independent governmental agency that is responsible for the national core curriculum document and its reform approximately every ten years (Vitikka et al., 2016). The national core curriculum is a guiding yet normative document that provides the framework for local curriculum and school practice. The core curriculum includes the mission and values of basic education, objectives and core content of school subjects, a general framework for the development of the school culture, and principles for pupil assessment (FNBE, 2014). It functions as an instrument for constructing a shared understanding of the values and aims of schools, and as a foundation upon which teachers build their pedagogical practice (Vitikka et al., 2016).

Finnish education providers have considerable autonomy in organizing education. The local education providers, generally municipalities, are obliged to follow the national core curriculum and are responsible for the quality of their education. National inspection of schools or teachers is not used and school assessment is primarily based on self-evaluation (Kumpulainen & Lankinen, 2016; Sahlberg, 2015). Learning outcomes are mainly assessed by sample-based evaluations, which assess the outcomes in relation to the national core curriculum's objectives (Kumpulainen & Lankinen, 2016). The purpose of the evaluations is to ensure equity and quality in education, and to enhance and

develop curricula and education at all levels of the system (Kumpulainen & Lankinen, 2016; Sahlberg, 2015).

Confidence in the professionalism of teachers characterizes the Finnish educational system (Sahlberg, 2015). Teaching is a valued profession and applying for teacher education is highly competitive, with only about ten percent of the applicants accepted (Paronen & Lappi, 2018). Teachers complete a master's degree, including practice in training schools that collaborate with universities. Almost all teachers in Finnish schools are qualified (Paronen & Lappi, 2018). Principals in Finnish schools are also qualified teachers, and the majority of principals regularly teach in their schools. Pupil assessment is largely carried out by teachers, and there is no large-scale national testing system of all pupils in comprehensive school (Kumpulainen & Lankinen, 2016; Vitikka et al., 2016). Moreover, teachers have pedagogical autonomy in choosing teaching methods and materials. Although learning materials have also been shown to play a guiding role in teachers' work (e.g. Heinonen, 2005; Sulonen et al., 2010), the relative role of curriculum in teachers' planning has increased (Atjonen et al., 2008). This may be because teachers have been more closely involved in the processes of curriculum development work in the latest curriculum reforms and the importance of local curriculum development as a means for learning has been emphasized.

Overall, the Finnish approach to school development can be characterized as a *top-down-bottom-up approach* (Pietarinen et al., 2017). Generally, the top-down is considered necessary to clarify a shared direction for the whole system to generate coherence in the system-level, while the bottom-up is required to facilitate various stakeholders' involvement and commitment in the change effort, promoting the transfer of reform ownership to local levels (Darling-Hammond 1998; Fullan, 1993; Halinen & Holappa, 2013; Smith & O'Day, 1991; Vitikka et al., 2016). While the Finnish national core curriculum is a normative document that guides school practice and development, local autonomy and distributed curriculum leadership emphasize consensus-building and shifting responsibility to the local education providers (Atjonen, 1993; Kohonen, 2001; Nevalainen, Kimonen & Hämäläinen, 2001; Tian & Risku, 2019). The national core curriculum is not detailed and prescriptive, but rather aims to support local operationalization, while the local districts and schools have autonomy in local curriculum development. Collaboration and shared goals among educational administrators, stakeholders and practitioners are emphasized in the Finnish reform process (Salonen-Hakomäki, Soini, Pietarinen & Pyhältö, 2016; Tikkanen, Pyhältö, Soini & Pietarinen, 2017; Vitikka et al., 2016). Thus, the curriculum coherence perceived by educational stakeholders is proposed to be particularly important in the Finnish curriculum reform process, because the process aims to provide autonomy and to commit the local stakeholders and practitioners to continous school development by involving them in the local curriculum work (Mølstad, 2015; Pietarinen et al., 2017; Vitikka et al., 2016).

2.2 Core curriculum reform 2014

The most recent core curriculum reform was launched in 2012. The construction of the core curriculum was an interactive process involving a network of stakeholders, including administrators, researchers, teacher educators, municipal education providers, representatives from associations, principals, teachers and other educational experts (Halinen & Holappa, 2013; Vitikka et al., 2016). They were invited to participate in state-level working groups focusing on different parts and content of the core curriculum. Together these working groups were also responsible for writing the new core curriculum document, which was finished at the end of 2014. Experiences of key stakeholders, research and lessons learned from the evaluations of previous curricula formed the basis for the core curriculum development process (Halinen & Holappa, 2013). Moreover, drafts of the core curriculum were open for the public to comment on for specific periods.

The Finnish curriculum model originates from a combination of the subject-centered Lehrplan-model originated from Herbart and the child-centered curriculum model originated from Dewey (Malinen, 1992; Vitikka, 2009). Accordingly, the Finnish core curriculum has traditionally consisted of a general part that establishes general aims and principles for basic education, as well as a subject-specific part that includes the content and objectives of each school subject (Vitikka, 2009). The balance between separate subjects and different forms of integration has been under continous discussion (Vitikka, 2009). The new core curriculum published in 2014 integrates subject-based and competence-based learning by focusing on developing transversal competencies in addition to subject content (Finnish National Board of Education, 2014). Transversal or generic competencies have emerged as part of the curriculum in many countries (OECD, 2005; Voogt & Roblin, 2012) and the 2014 Finnish core curriculum established transversal competencies for the first time as learning goals to be developed throughout all school subjects (Vitikka et al., 2016). Yet, the Finnish approach to curriculum development is unique in many ways (Sahlberg, 2015; Tian & Risku, 2019). For instance, high-stakes testing and measurement have not been combined with the development towards a more process-oriented curriculum (Tian & Risku, 2019). The core curriculum aims to promote student autonomy, integration across school subjects and versatile working methods and learning environments. The new core curriculum also emphasizes collaborative and active learning, sustainability and the uniqueness of each pupil (FNBE, 2014).

Moreover, a holistic approach to teaching can be seen as a long-term aim of the Finnish basic education (Niemelä & Tirri, 2018). Aiming towards harmonizing teaching and learning, integration of content and subjects, and applying learning to a larger purpose are not new principles in the Finnish core curriculum. Similar aims have been part of previous core curricula in various forms and extent (Atjonen, 1993; Niemelä, 2019), although at the same time, the core curriculum has been strongly subject-based (Vitikka, 2009). However, the

emphasis on the kind of integration that is promoted has varied over time. For instance, after the establishment of the comprehensive school system in 1970, the core curriculum encouraged various options for integration, such as cross-curricular themes, but their implementation was not compulsory (Komiteanmietintö, 1970; Niemelä & Tirri, 2018). The current core curriculum of 2014 requires at least one multidisciplinary learning unit to be organized for all pupils each school year. Integration is combined with promoting pupil-centered instruction, such as inquiry learning (FNBE, 2014). Overall, the 2014 core curriculum can be considered to provide more guidance on the *how* of teaching and learning, when compared with the previous core curricula. Still, teachers have the pedagogical freedom to plan their teaching.

On the basis of the national core curriculum, local curricula are developed. The local education providers are considered to be important stakeholders involved with and engaged in the top-down-bottom-up approach to school development (Pietarinen et al., 2017; Tian & Risku, 2019; Vitikka et al., 2016). Hence, the education providers are responsible for constructing a local curriculum, usually for an individual municipality or as a district-level collaboration among several municipalities (Halinen & Holappa, 2013). These district-level curricula are developed in the framework of the national core curriculum, yet taking into account local values, local environment, and resources (Niemi, 2015; Vitikka et al., 2016). The district-level curriculum development work is typically orchestrated in collaboration between municipal actors and educational practitioners from the schools (Pyhältö, Pietarinen & Soini, 2018; Vitikka et al., 2016). The education providers may also involve the local community in the local curriculum process (Niemi, 2015). The local curricula were to be finished by the spring of 2016 and implementation of the new curriculum started in the fall of 2016 in primary schools and continued in phases during 2017-2019 in lower-secondary schools.

Stakeholders at the school-district-level have an important role as they interpret, integrate and transform the general principles of the core curriculum into a local curriculum that emphasizes the aims, content and values from a local perspective. The broad aims promoted in the Finnish core curriculum are not measured by external accountability, but rather, the local education providers have considerable autonomy in drafting the local curriculum and making their own choices based on the local needs (Niemi, 2015). On the other hand, because of this autonomy, municipalities and schools may vary in terms of how they interpret and understand the core curriculum as a tool for developing local school practice. For instance, variations in organization and levels of participation in local curriculum processes have been identified (Tian & Risku, 2019).

3 Aim and research questions

The overall aim in this dissertation was to gain a better understanding of the function of curriculum coherence in large-scale curriculum reform by exploring the anatomy of curriculum coherence and by examining how educational stakeholders, including state- and district-level stakeholders and teachers, perceived the curriculum coherence in the context of the Finnish national core curriculum reform. Also, the interrelation between curriculum coherence and the reform's impact on the school development work was analysed. The following research questions were addressed:

1) What is curriculum coherence comprised of?
2) How do state- and district-level stakeholders and teachers perceive curriculum coherence, and what variations can be detected between the different-level stakeholders and among the individuals?
3) How does curriculum coherence contribute to the expected school impact of the curriculum reform work?

These questions were addressed through three part studies, each with its specific hypotheses. *Study I* explored the anatomy of perceived curriculum coherence, as well as its relation with the perceived school-level impact of the reform work. *Study II* focused on identifying individual variation in state- and district-level stakeholders' perceptions of curriculum coherence and school impact, as well as examining differences between the stakeholder groups. Finally, in *study III*, profiles of comprehensive school teachers' perceived curriculum coherence were identified and the development of these perceptions was examined over a one-year follow-up period. The profiles were also examined in relation to teachers' expectations of the reform's impact on school development.

4 Methods

A quantitative research design was utilised in order to explore educational stakeholders' perceptions of curriculum coherence at different levels of the school system in the context of a large-scale curriculum reform (Creswell, 2014). A systemic research design (see Confrey et al., 2000) was applied in order to investigate differences and similarities in the perceived curriculum coherence throughout the levels of the educational system, examining variation both in individual patterns and between levels of the educational system. The research design included data collected from all three levels of the national curriculum reform process: state, districts, and schools (Figure 2). *Studies I* and *II* were based on cross-sectional survey data, whereas in *study III*, longitudinal data from teachers with two measurements over a one-year follow-up period during the beginning of the curriculum implementation was utilised. Hence, the research design followed the curriculum reform in terms of the phase of the reform process by collecting data from the different level stakeholders that were involved in the curriculum development work at the time of the data collection.
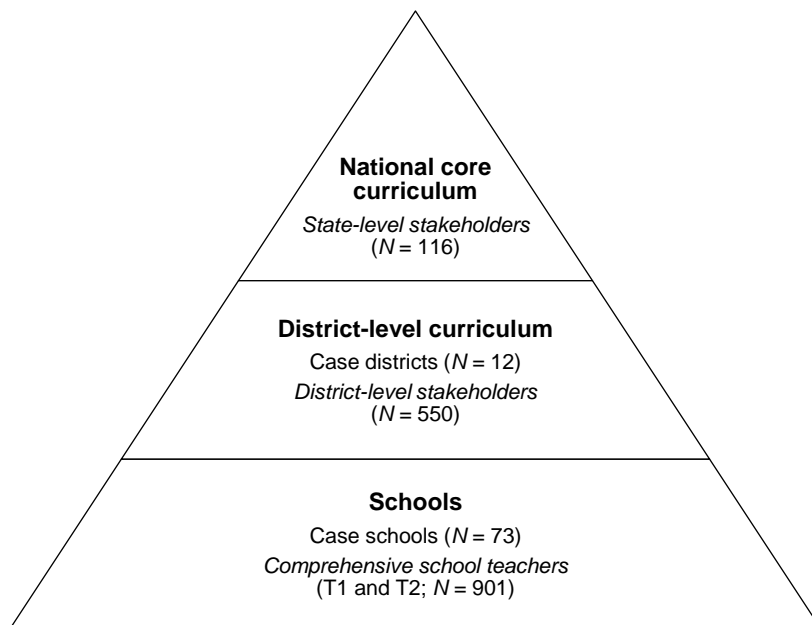

Figure 2. Systemic approach to exploring perceived curriculum coherence.

In this dissertation, variable-centered and person-centered methodological approaches have been combined (see e.g. Bergman & El-Khouri, 2003; Bergman & Trost, 2006; Laursen & Hoff, 2006). The variable-centered approach was utilised to gain information about the anatomy of perceived curriculum coherence

and on the hypothesized relation between curriculum coherence and school impact. The person-centered approach (Magnusson & Stattin, 1998) was used to explore variation between individuals to understand better the different educational stakeholders' experiences of curriculum coherence and expectations of the curriculum reform's impact on school development. Confirmatory factor analysis was used in the first part study to examine the structure and elements of the curriculum coherence scale with the data from district-level stakeholders involved in the development of local curricula (research question 1). Moreover, structural equation modeling was utilised (*study I*) to examine the relation between curriculum coherence and the perceived impact of the reform work on school-level development (research question 3). Latent profile analysis was used to identify subgroups of individuals based on their response patterns (research question 2) (*studies II and III*). Individual variation in perceived curriculum coherence and school impact among the state- and district-level stakeholders, as well as differences between the two participant cohorts was examined (*study II*). Also examined were individual variations in comprehensive school teachers' perceptions of curriculum coherence and their development over the first year of curriculum implementation in schools (*study III*).

The dissertation is part of the national School matters research project (2013-2018), funded by the Ministry of Education and Culture and conducted in a national collaboration by four Finnish universities. The data used in this study were part of the research project and were collected in collaboration by the research group.

4.1 Participants and procedures

The participants consisted of three cohorts of stakeholders from different levels of the Finnish national curriculum reform process (Figure 2): 1) *state-level stakeholders*, 2) *district-level stakeholders*, and 3) *comprehensive school teachers*.

The state-level stakeholders (N = 116) were involved in working groups that were responsible for constructing the national core curriculum in Finland. The data were collected by the research group using an electronic survey in 2014, while the state-level working groups were finalizing the new national core curriculum document. The state-level stakeholders consisted of school teachers (n = 51, 44%), university teachers (n = 30, 26%), association representatives (n = 7, 6%), and officials from the Finnish National Board of Education and Ministry of Education and Culture (n = 22, 19%). Most of the respondents (n = 85, 73%) were women and the minority men (n = 29, 25%). Most of the participants (n = 87, 75%) reported that this was the first time they had been involved in the state-level working groups in the core curriculum reform. The mean age of the participants was 51.53 years (SD = 7.82; Min/Max = 32/65). The response rate was 37 percent

and the sample represented the stakeholders involved in the development of the national core curriculum in terms of regions, affiliations and gender (Pietarinen et al., 2017).

The district-level stakeholders ($N = 550$) were responsible for developing the local curriculum as members of curriculum development working groups in 12 case districts. The case districts were selected to represent variations in terms of the geographical location and the organization of the local curriculum reform work. The organization of the local curriculum process varied from conducting the curriculum development in a single municipality to collaboration between several neighboring municipalities. Hence, the working groups included members from a total of 54 municipalities in Finland, which together represent 17% of Finnish municipalities. The size of the working groups also varied. The municipalities represented different-sized urban and rural municipalities, and were located throughout Finland. The district-level data were collected using electronic and paper surveys during spring 2016, when the local curricula were being finalized. The district-level participants included teachers ($n = 403$, 73%), school leaders and principals ($n = 101$, 18%), and other educational experts such as municipal administrators, coordinators and student counsellors ($n = 28$, 5%). Constitution of the working groups (see also Pyhältö et al., 2018) followed a similar distribution regarding the utilised expertise across the country; the majority were teachers and educational leaders, and in turn, a minority were municipal administrators, coordinators and other school staff. Hence, the sample is sufficiently representative in terms of the different educational stakeholders involved in district-level curriculum work in Finland. Most of the district level respondents were women ($n = 408$, 74%) and the minority men ($n = 131$, 24%). Over half ($n = 335$, 61%) of the participants had previous experience in curriculum development work. The mean age of the participants was 46.03 years (SD = 8.81; Min/Max = 26/71).

The comprehensive school teachers ($N = 901$) included teachers from 73 case schools from six of the case districts around Finland. The six districts varied in terms of location in both urban and rural areas. The case schools were selected to represent variation in the socio-economic status of the areas they were in, as well as in school size. The data were collected for the first time in the fall of 2016, when the implementation of the new curriculum had started in primary schools. The second measurement was in the fall of 2017 when the implementation extended to grade 7 of lower-secondary schools. The data collection was conducted by the research group in school staff meetings using paper surveys. A total of 1556 teachers responded at Time 1 (2016), and 1585 at Time 2 (2017), and the response rate ranged from 79.2 to 81.2 percent of all teachers in the case schools. The longitudinal data set used in *study III* comprises the 901 teachers who identifiably responded at both time points. Thus, these teachers represented 58 percent of the total sample at T1. Half of the teachers in the sample ($n = 452$, 50%)

taught in primary schools (grades 1-6), 15 percent ($n = 137$) in lower-secondary schools (grades 7-9), and 35 percent ($n = 312$) in combined primary and lower-secondary schools (grades 1-9) at T1. The respondents also included principals and vice principals (11%; $n = 97$), most of whom also taught in their schools. Similar to the other cohorts, most of the teachers were women (75%, $n = 676$), men being in the minority (25%, $n = 224$), which represents the gender distribution of Finnish teachers (77% female) well (Paronen & Lappi, 2018). The teachers' average teaching experience was 16 years at T1 (SD = 9.2; min/max = 0/40).

4.2 Measures

The three participant cohorts responded to the Curriculum Reform Inventory (Pietarinen et al., 2017), which included the same measures for curriculum coherence and school impact, among other scales. The scales were developed for the research project and piloted and commented on by two experienced stakeholders before data collection. Items of the scales used in this study were all rated on a seven-point Likert-scale (1 = fully disagree; 7 = fully agree).

The curriculum coherence scale considers the perceptions of the core curriculum document and was hypothesized to include three complementary factors: consistency of the intended direction, an integrative approach to teaching and learning, and alignment between objectives, content and assessment. *Consistency of the intended direction* (CON, 6 items) refers to establishing a consistent direction for school practice in terms of clarifying and supporting the work of schools and teachers, summarizing the most important goals, and supporting the teaching of essential material (e.g. "*The national core curriculum delimits the duty of the school in a sensible manner*"). The reliability of the scale was consistent through the part studies (α = .86–.89). *The integrative approach to teaching and learning* (INT, 4 items) entails a novel approach to harmonizing teaching and encouraging teachers to use activating methods and assessment that support learning (e.g. "*The national core curriculum supports the harmonisation of teaching*"). Reliability of the scale was adequate (α = .74–.77). Finally, *alignment between objectives, content and assessment* (ALI, 7 items), refers to the connectedness linking objectives, content, instruction, and assessment, as well as acknowledging the pupils' age range in the continuity of the curriculum (e.g. "*In the national core curriculum the goals are in line with the assessment criteria*"). The reliability of the alignment scale was consistent (α = .84–.88).

The school impact scale (SCI, 6 items) used in this study was adapted from the scale used by Pietarinen et al. (2017), focusing on the potential effects of the reform process on the school-level development work. It measures the expectations of how well the reform process directs the development work towards locally functional solutions and sustains active development work at

schools (e.g. "*The work to reform the curriculum commits teachers to working on developing the school*"). The reliability of the scale was high ($\alpha = .87–.91$).

Full scales are shown in Table 1. The percentage of missing values per item in each data set ranged from 0 to 4.4. The analyses were conducted with Mplus using the full information maximum likelihood (FIML) method, utilising all the available information in the data without deletion or imputation of missing values (Hair, Black, Babin & Anderson, 2014; Schafer & Graham, 2002).

Table 1. Curriculum coherence and school impact scales.

CURRICULUM COHERENCE

Consistency of the intended direction

(In) the national core curriculum…

Con11: clarifies the entity of a teacher's job
Con12: supports the teaching of the essential material in various subjects
Con13: delimits the duty of the school in a sensible manner
Con14: is clear and well organised
Con15: successfully sums up the most important goals for the operation of the school
Con16: constitutes an aligned foundation for the local curricular work

Integrative approach to teaching and learning

(In) the national core curriculum…

Int21: encourages teachers to use activating and engaging teaching methods
Int22: encourages teachers to use assessment methods that support learning
Int23: supports the harmonisation of teaching
Int24: the general section creates something new

Alignment between objectives, content and assessments

(In) the national core curriculum…

Ali31: the goals are in line with the assessment criteria
Ali32: a subject constitutes an integral continuum
Ali33: the goals are in line with contents
Ali34: takes a pupil's age range into consideration
Ali35: descriptions of teaching methods in various subjects are in harmony with the general goals
Ali36: constitutes an integral whole
Ali37: the goals of the general section are also well in evidence in the subject section

SCHOOL IMPACT

The work to reform the curriculum…

Sci1: maintains active development work at schools
Sci2: commits teachers to working on developing the school
Sci3: helps the school community identify the core tasks
Sci4: directs development work to resolve problems observed in the daily life of the school
Sci5: helps people develop solutions that work at the local level for organizing teaching
Sci6: promotes the resolution of many problems related to basic education at the local level

Note. Translated from Finnish. Rated on a seven-point Likert-scale (1 = fully disagree; 7 = fully agree).

4.3 Analyses

4.3.1 Structural equation modeling and confirmatory factor analysis

Structural equation modeling (SEM) is a family of multivariate analysis methods that can be used to examine unobserved latent constructs and regression structures among those constructs (Bollen, 1989; Ullman, 2007). A SEM model usually consists of a measurement model, that defines the relations between continous latent constructs and observed dependent variables used as factor indicators, and the full structural model, which defines the relationships between latent constructs (Byrne, 2012; Muthén & Muthén, 1998-2015; Ullman, 2007). This enabled the examination of the relation between curriculum coherence and school impact using latent variables.

Confirmatory factor analysis (CFA) is an analysis approach that tests a hypothesized measurement model, i.e. the hypothesized structure of a construct measured with certain observed variables (Byrne, 2012). The relations between the observed indicator variables and the latent factors are defined as a set of linear regression equations (Muthén & Muthén, 1998-2015). CFA makes it possible to test the hypothesized model of perceived curriculum coherence, to compare different models and to assess the model fit, which is not possible with exploratory approaches (Bollen, 1989; Byrne, 2012).

In this study, CFA and SEM were conducted with Mplus version 7.4 (Muthén & Muthén, 1998-2015). Missing data were included in the analysis using the full information maximum likelihood (FIML) method, which utilises all the available information (Schafer & Graham, 2002). As some of the items were slightly negatively skewed, the MLR estimator, which uses maximum likelihood estimation with standard errors and chi-square statistics that are robust to non-normality, was utilised (Muthén & Muthén, 1998-2015).

It is recommended that the model fit in CFA and SEM is assessed with multiple criteria (Byrne, 2012; Hair et al., 2014; Ullman, 2007). The chi-square test of fit has been shown to be sensitive to sample size and non-normality (Byrne, 2012; Ullman, 2007). Comparative fit indices including the comparative fit index (CFI) and the Tucker-Lewin index (TLI), and absolute indices of fit including the root mean square error of approximation (RMSEA), and a residual-based fit index, the standardized root mean square residual (SRMR), were utilised to assess model fit in this dissertation. Model fit was evaluated with the following criteria indicating acceptable fit: CFI/TLI > .90, RMSEA < .08, and SRMR < .05 (Byrne, 2012; Hu & Bentler, 1999; Marsh, Hau & Wen, 2004). Item reliability was estimated by the squared multiple correlations and the structural validity by the standardised factor loadings (Hair et al., 2014). The internal consistency of the scales was examined by estimating the factor determinacies and Cronbach's alphas.

To examine the anatomy of curriculum coherence (research question 1), confirmatory factor analysis (CFA) was utilised. In particular, in *study I*, CFA was used to test whether the hypothesized second-order three-factor model of curriculum coherence fit the data. The hypothesized second-order measurement model was compared with one-factor model and three-factor model with correlated factors. A second-order model with three first-order factors, as is the case with the second-order model of curriculum coherence, is a just-identified model (Byrne, 2012), meaning that the second-order part of the model has just enough degrees of freedom to estimate the free parameters (Hair et al., 2014). Hence, comparing the model to the three-factor model with the goodness-of-fit indices was not possible without any additional restrictions to the model. Thus, the second-order model was evaluated content-wise and in terms of the model parameters.

In the final model of curriculum coherence, one within-factor residual covariance between items Ali33 and Ali35 was freed, since the items concerned similar aspects within the alignment factor, the existing model already showed acceptable fit, and the residual covariance improved the model fit in each data set (Byrne, 2012).

The one-factor measurement model of school impact was also examined with CFA before adding it into the structural equation model in *study I*. Additionally, CFA was used in *studies II* and *III* to initially examine the structure of the scales. The same measurement models for curriculum coherence and school impact fit the data sufficiently well in each cross-sectional and longitudinal data set.

To answer research question 3, concerning the interrelation between curriculum coherence and the reform's school impact, a structural model was tested in *study I*. The second-order factor of curriculum coherence, confirmed with the initial CFA, was used as a predictor of the latent construct of school impact. The SEM model was also analysed with the MLR estimator, which produces maximum likelihood estimates with standard errors and Chi-square test statistics that are robust to non-normality (Muthén & Muthén, 1998-2015). Model fit was estimated using the same criteria as in the CFA analysis.

4.3.2 Measurement invariance

To ensure that measurements from different stakeholders and between time points measured the same latent constructs, measurement invariance was analyzed between state- and district-level stakeholders in *study II*, and between the two time points of measurement from teachers in *study III*. Measurement invariance refers to testing the psychometric equivalence of a construct between groups or measurement occasions (Chen, Sousa & West, 2005; Putnick & Bornstein, 2016; Wang & Wang, 2012). The configural model tests the equality of the basic structure of the model, i.e. that the same number of items load onto the same

factors. Metric invariance tests the equality of factor loadings, i.e. that each item contributes to the latent factor to a similar degree across the groups, whereas the scalar invariance model also includes the equality of the intercepts (Putnick & Bornstein, 2016). Scalar invariance, meaning that the scores are equal in terms of the unit and origin of measurement, is usually considered as a requirement for comparing latent means across groups or time points (Chen et al., 2005; Wang & Wang, 2012).

The configural model, metric invariance model, and scalar invariance model were compared by examining changes in CFI, TLI, and RMSEA (Chen et al., 2005; Cheung & Rensvold, 2002; Wang & Wang, 2012). In this study, a change over -.005 in CFI and TLI values, and a change over .010 in RMSEA were used as cut-off values showing decreased fit that would reject each tested, more constrained model (see Chen, 2007; Cheung & Rensvold, 2002). Since full scalar invariance was not supported when testing the between-group invariance between the cohorts of *study II*, partial scalar invariance was tested by releasing some non-invariant intercepts in the models (Byrne, Shavelson & Muthén, 1989). In the analyses of measurement invariance in *studies II* and *III*, the three-factor model of curriculum coherence was tested, because the three elements of coherence were used as profile indicators instead of using the higher-order construct of curriculum coherence.

In *study II*, measurement invariance in terms of the curriculum coherence and school impact scales was tested between the state- and district-level stakeholders. For both scales, full metric invariance was established. Partial scalar invariance was also supported, with two noninvariant intercepts (Ali35, Ali36) in the curriculum coherence scale and two noninvariant intercepts in the school impact scale (Sci2, Sci6). Hence, the state- and district-level stakeholders seem to have responded at systematically slightly different response levels to these noninvariant items regardless of invariant factor loadings. However, most of the intercepts of the scales were invariant, which was considered a sufficient basis for the further analysis that was conducted with observed mean scores, thus not comparing latent means between the groups.

Measurement invariance between the two measurements of the one-year follow-up from teachers was examined in *study III*. Full metric and full scalar invariance was established for the three-factor model of curriculum coherence and one-factor model of school impact. Thus, the measurements were consistent in measuring the same latent constructs over the time points. For the purposes of this dissertation, measurement invariance across all participant cohorts, state- and district-level stakeholders and teachers at T1, was also examined. The results supported full metric invariance and partial scalar invariance with two invariant intercepts in the curriculum coherence scale and two in the school impact scale. Hence, overall the scales were relatively consistent in measuring the same

constructs across the participant cohorts that represented different roles in the curriculum reform process.

4.3.3 Intraclass correlation and design effect

The intra-class correlation coefficient (ICC) estimates the proportion of variance between groups in clustered designs (Snijders & Bosker, 2012). Since school-level factors have also been identified as important determinants for school development in the previous literature (e.g. Geijsel et al., 2001; Newmann et al., 2001; Spillane, Halverson & Diamond, 2004; Thoonen, Sleegers, Oort & Peetsma, 2012), the possible school-level variation in teachers' perceptions of curriculum coherence and school impact was initially examined before conducting the person-oriented analysis. The effect of the nested structure of the data in *study III* with teachers within schools was examined with ICC and design effect (*deff*), which estimates the effect of the clustered design and between-group variance weighted by the average cluster size.

The school-level variation in teachers' perceived curriculum coherence and school impact ranged between 3–13 percent (*study III*). The school-level variation exceeded 10 percent only in the consistency of the intended direction at the second measurement. Most of the intraclass correlation coefficients showed that a rather small amount of the variance in teachers' experiences of curriculum coherence and expectations of the reform's school-level impact was located at the school-level. Accordingly, the person-oriented analysis was considered suitable for examining the individual variation in the perceptions of teachers, which was the aim of *study III*.

4.3.4 Latent profile analysis

To examine the individual variation in educational stakeholders' perceptions of curriculum coherence (research question 2), a person-centered approach was used in *studies II* and *III*. Latent profile analysis (LPA) is a mixture modeling technique the aim of which is to detect homogenous subgroups of individuals based on continous indicator variables (Berlin, Williams & Parra, 2014; Lubke & Muthén, 2005; Muthén & Muthén, 1998-2015; Vermunt & Magidson, 2002). The results give each individual probabilities of belonging to each profile. The latent profile models were chosen with an exploratory approach, i.e. conducting the latent profile model for different number of profiles, to be able to compare and choose the best model to represent the data. The Akaike (AIC), Bayesian (BIC) and adjusted Bayesian (aBIC) information-based measures of fit, and Vuong–Lo–Mendell–Rubin (VLMR), Lo–Mendell–Rubin (aLRT) and bootstrapped (BLRT) likelihood ratio tests were used to compare the latent profile models (Berlin et al., 2014; Nylund, Asparouhov & Muthén, 2007). The average latent class

probabilities and entropy statistics were also examined to evaluate the clarity of the different solutions.

In *study II*, the data sets of both the state- and district-level stakeholders were combined. The indicator variables used in the LPA consisted of the observed mean scores for the three elements of curriculum coherence and for school impact, since the two constructs were assumed to be related, based on the results from the SEM model in *study I*. The within-profile variances were constrained equal between profiles, however the residual covariances between the indicators were freed.

The latent profile models, based on state- and district-level stakeholders' perceptions of curriculum coherence and school impact, estimating 1 through 6 profiles are shown in Table 2. All the fit indices showed that the two-profile model represented the data better than the one-profile model. The VLMR and aLRT tests showed no improvement of fit after the two-profile model, although the AIC, BIC, and aBIC continued to decrease, thus suggesting additional profiles. The BIC reached its lowest value in the five-profile model, thus suggesting it would fit the data best. The BLRT test also showed significant increases of fit until the five-profile model. However, it seemed that the largest profile remained relatively stable in the different profile models with 538-555 members. Thus, it was not considered that the additional profiles added any substantive value, and the two-profile solution, supported by the VLMR and aLRT tests, was chosen as the more parsimonious model for further analysis. After the latent profile model was chosen, the dichotomous variable for the participant cohort (state- or district-level stakeholder) was added as an auxiliary predictor variable in multinomial logistic regression predicting the latent profile membership using the three-step approach in Mplus (Asparouhov & Muthén, 2014a).

Table 2. The latent profile models of state- and district-level stakeholders.

No. profiles	LogL (nf)	AIC	BIC	aBIC	Entropy	Latent profile probabilities	VLMR	aLRT	BLRT	Profile counts[a]
1	-2834.49 (14)	5696.98	5760.00	5715.55	N/A	1.000	N/A	N/A	N/A	666
2	**-2804.54 (19)**	**5647.07**	**5732.60**	**5672.27**	**.76**	**0.95, 0.86**	**.00**	**.00**	**.00**	**555, 111 (573, 93)**
3	-2780.42 (24)	5608.85	5716.88	5640.68	.81	0.82, 0.89, 0.94	.29	.30	.00	98, 31, 538 (84, 25, 557)
4	-2763.60 (29)	5585.20	5715.74	5623.66	.85	0.76, 0.91, 0.94, 0.78	.48	.49	.00	52, 27, 543, 43 (43, 23, 562, 38)
5	-2747.26 (34)	5562.52	5715.57	5607.61	.87	0.80, 0.85, 0.94, 0.78, 0.95	.13	.14	.00	47, 16, 10, 44, 549 (36, 13, 9, 39, 569)
6	-2738.51 (39)	5555.02	5730.57	5606.75	.88	0.92, 0.76, 0.81, 0.92, 0.79, 0.94	.15	.15	.08	6, 15, 38, 10, 55, 543 (5, 13, 29, 9, 43, 567)

Note. LogL = log likelihood value; nf = number of free parameters; AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; VLMR = Vuong-Lo-Mendell-Rubin likelihood ratio test; aLRT = Lo-Mendell-Rubin adjusted likelihood ratio test; BLRT = bootstrapped likelihood ratio test. The selected model is in boldface.

[a] Profile counts based on estimated posterior probabilities and classification of individuals based on their most likely latent profile membership (in parenthesis).

In *study III*, participants included comprehensive school teachers, and the longitudinal data included two measurements over a one-year follow-up period. As the focus was on the development of teachers' perceptions of curriculum coherence, the observed mean scores from two measurements of each element of curriculum coherence were used as the indicator variables. The residual covariances between the two measurements of each subscale were utilised to model the dependence between the two measurements. The within-profile variances were constrained equal between profiles. The analysis was conducted to estimate 1 to 7 profile solutions (Table 3).

Table 3. The latent profile models of teachers.

No. profiles	LogL (nf)	AIC	BIC	aBIC	Entropy	Latent profile probabilities	VLMR	aLRT	BLRT	Profile counts[a]
1	-6287.90 (15)	12605.80	12677.85	12630.21	N/A	1.000	N/A	N/A	N/A	901
2	-5847.92 (22)	11739.83	11845.51	11775.64	.78	0.93, 0.94	.00	.00	.00	333, 568 (324, 577)
3	-5624.83 (29)	11307.66	11446.96	11354.86	.81	0.91, 0.91, 0.91	.01	.01	.00	175, 487, 239 (173, 495, 233)
4	-5527.77 (36)	11127.54	11300.47	11186.14	.84	0.95, 0.90, 0.91, 0.91	.09	.10	.00	30, 227, 444, 200 (29, 225, 448, 197)
5	**-5446.70 (43)**	**10979.40**	**11185.95**	**11049.39**	**.82**	**0.98, 0.89, 0.86, 0.83, 0.91**	**.03**	**.03**	**.00**	**24, 429, 82, 177, 189 (23, 437, 83, 172, 186)**
6	-5378.84 (50)	10857.67	11097.85	10939.06	.78	0.95, 0.89, 0.84, 0.82, 0.89, 0.78	.16	.17	.00	25, 87, 183, 310, 152, 144 (24, 87, 179, 322, 149, 140)
7	-5326.44 (57)	10766.89	11040.68	10859.66	.80	0.98, 0.83, 0.87, 0.79, 0.94, 0.82, 0.90	.10	.11	.00	24, 171, 86, 134, 13, 317, 156 (22, 166, 87, 127, 12, 334, 153)

Note. LogL = log likelihood value; nf = number of free parameters; AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; VLMR = Vuong-Lo-Mendell-Rubin likelihood ratio test; aLRT = Lo-Mendell-Rubin adjusted likelihood ratio test; BLRT = bootstrapped likelihood ratio test. The selected model is in boldface.

[a] Profile counts based on estimated posterior probabilities and the classification of individuals based on their most likely latent profile membership (in parenthesis).

The AIC, BIC, and aBIC indices did not reach their lowest values as they showed decreasing values until the seven-profile model. Moreover, the BLRT suggested improving fit with each additional profile. The VLMR and aLRT likelihood ratio tests indicated that the two-, three-, and five-profile models showed increasing fit compared to the previous k-1 models. Neither the sixth not the seventh profile showed improving fit with these indicators. Hence, the five-profile model was chosen for further analysis based on the VLMR and aLRT likelihood ratio tests. According to the entropy value and the average latent profile probabilities, the five profiles also showed sufficient separation.

The development of the teachers' perceptions was further examined with paired-samples t-tests after exporting the latent profile solution to SPSS using the most likely profile memberships. Moreover, differences across the profiles in the perceived school impact of the reform work were examined by adding the mean

scores for school impact at Times 1 and 2 into the latent profile model as auxiliary variables using the BCH setting in Mplus (Asparouhov & Muthén, 2014b; Muthén & Muthén, 1998-2015). The BCH method is recommended for tests of the equality of means between profiles for continous outcome variables (Asparouhov & Muthén, 2014b; Muthén & Muthén, 1998-2015). When adding the auxiliary variables, the latent profile solution is not affected by these variables, and the misclassification of the latent profile solution is taken into account (Asparouhov & Muthén, 2014b). Thus, the results are more reliable than when comparing the means between groups created from the most likely profile memberships.

4.4 Summary of the aims and methods

In this dissertation, perceptions about curriculum coherence by educational stakeholders at different levels of the educational system were explored in the context of Finnish national curriculum reform process. Survey data were collected from three cohorts: members of the state-level core curriculum development working groups; members of the district-level curriculum working groups in 12 case districts around Finland; and comprehensive school teachers from 73 case schools. Summary of the aims and methods of the original part studies is presented in Table 4.

Table 4. Summary of the aims and methods of the original part studies.

Study	Research questions	Main aims	Participants	Measurements	Analyses
I	1, 3	• To explore the anatomy of perceived curriculum coherence; • To examine the relation between curriculum coherence and expected school-level impact of the reform	*Cohort II*: District-level stakeholders ($N = 550$)	Spring 2016	CFA, SEM
II	2	• To identify profiles based on perceived curriculum coherence and school impact; • To examine whether different level stakeholders differ in the profile memberships	*Cohort I*: State-level stakeholders ($N = 116$), and *Cohort II*: District-level stakeholders ($N = 550$)	2014 Spring 2016	LPA
III	2, 3	• To identify profiles of perceived curriculum coherence measured at two time points; • To examine the development of perceived curriculum coherence over two time points; • To examine whether the profiles differ in terms of perceived school impact of the reform	*Cohort III*: Comprehensive school teachers ($N = 901$)	Fall 2016 (T1) Fall 2017 (T2)	LPA

5 Results

The main findings of the part studies are presented here according to the research questions for the dissertation. The results on the anatomy of curriculum coherence are presented first, followed by the patterns of perceived curriculum coherence and school impact by state- and district-level stakeholders, and trajectories of teachers' perceived curriculum coherence. Subsequently, the relationship between curriculum coherence and school impact is examined, and finally, an overview of perceived curriculum coherence and school impact through the educational system is provided. The results are presented in more detail in the original studies.

5.1 The anatomy of curriculum coherence

The structure of perceived curriculum coherence was examined with the data from district-level stakeholders ($N = 550$). The results showed that the three-factor model of curriculum coherence fit the data well (*study I*). Accordingly, the results showed that perceived curriculum coherence of the curriculum document was comprised of three complementary elements (research question 1):

1) Consistency of the intended direction (CON), entailing that the curriculum establishes a consistent foundation for school development, clarifying the roles, aims and mission of schools and teachers;
2) Integrative approach to teaching and learning (INT), including that the curriculum facilitates a novel approach to harmonizing teaching and learning by encouraging the use of activating and engaging teaching methods, and assessment that supports learning;
3) Alignment between objectives, content, and assessment (ALI), including that pupils' age range is acknowledged, subjects constitute continuing wholes, and that the aims, methods, content and assessment are aligned with each other within the curriculum.

The second-order model further suggested that the relations between the three factors of curriculum coherence are accounted for by a latent second-order factor for overall perceived curriculum coherence (Figure 3). Since the second-order part of the model with three factors is just-identified, statistical comparison to the three-factor primary model was not possible. Yet, it was considered that the second-order model provided a more parsimonious and interpretable model for the structural model since it was assumed that a higher-order factor of curriculum coherence underlies the three strongly correlated primary factors and the initial three-factor model also showed sufficient fit (*study I*). Hence, district-level

stakeholders' overall perceptions of curriculum coherence were comprised of three interrelated elements: consistency of the intended direction, an integrative approach to teaching and learning, and alignment between objectives, content and assessment.
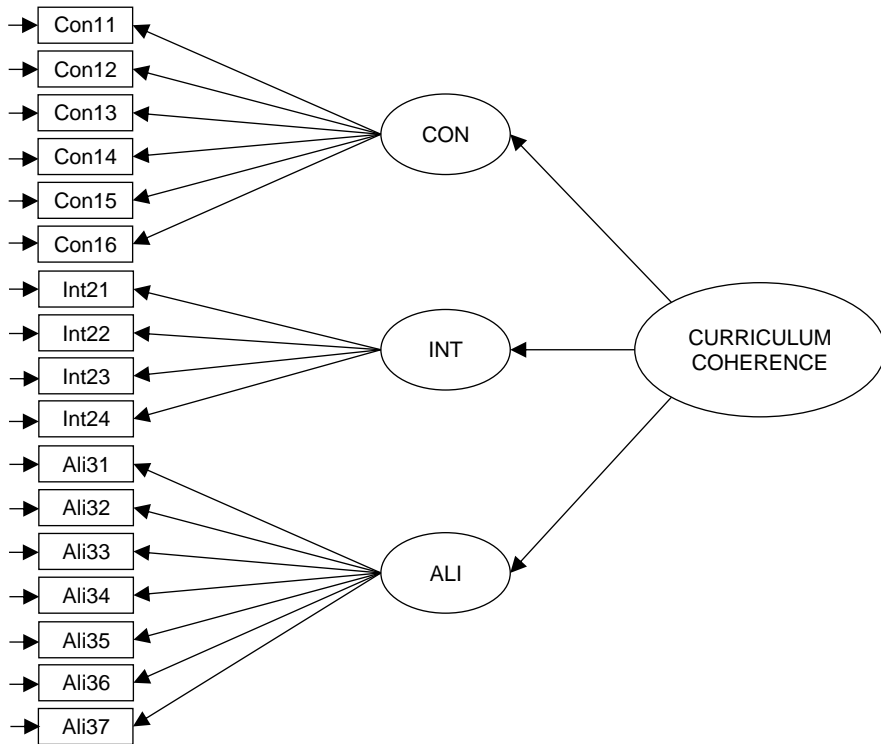
Figure 3. Measurement model of curriculum coherence, consisting of the consistency of the intended direction (CON), integrative approach to teaching and learning (INT), and alignment between objectives, content and assessment (ALI).

The structure of the perceived curriculum coherence also appeared to be similar when examined with the other stakeholder groups: state-level stakeholders and teachers (Table 5). Hence, the anatomy of curriculum coherence and school impact was stable regardless of the stakeholder group, as the results supported the same measurement models in each study. When examining individual variation in the state- and district-level stakeholders' and teachers' perceptions, the three-factor model of curriculum coherence was used (*studies II* and *III*) to gain a more detailed understanding of the patterns and relations between the elements of curriculum coherence.

Table 5. Results of confirmatory factor analyses.

Model	x^2	df	p	CFI	TLI	RMSEA [90%CI]	SRMR
Study I: district-level stakeholders (N = 550)							
Curriculum coherence[a]	287.47	115	<.001	.94	.93	.052 [.045–.060]	.04
School impact	24.59	9	<.01	.98	.97	.056 [.030–.083]	.03
Study II: state- and district-level stakeholders (N = 666)							
Curriculum coherence	298.38	115	<.001	.95	.94	.049 [.042–.056]	.04
School impact	26.14	9	<.01	.98	.97	.054 [.030–.078]	.02
Study III: comprehensive school teachers (N = 901)							
Curriculum coherence T1[b]	374.66	100	<.001	.95	.94	.055 [.049–.061]	.04
Curriculum coherence T2	480.52	115	<.001	.94	.93	.059 [.054–.065]	.04
School impact T1	82.00	9	<.001	.96	.94	.095 [.077–.114]	.03
School impact T2	57.12	9	<.001	.97	.95	.077 [.059–.097]	.03

[a] Second-order factor model of curriculum coherence was tested in *study I*, whereas a three-factor model was tested in *studies II* and *III*.

[b] Item Ali32 was missing in the T1 survey for technical reasons.

5.2 Patterns of perceived curriculum coherence and school impact by state- and district-level stakeholders

Two profiles based on the state- and district-level stakeholders' individual patterns of perceived curriculum coherence and school impact (research question 2) were detected from the combined data (*N* = 666; *study II*). Most of the respondents (83%; *n* = 555) belonged to the *High coherence and impact* profile that experienced all elements of curriculum coherence to be rather well evident in the core curriculum (Figure 4). Moreover, they evaluated the impact of the reform process on school-level development to be quite strong. The second latent profile *Lower consistency of the intended direction and impact* included 17% (*n* = 111) of the sample of state- and district-level stakeholders. They had lower perceptions of the consistency of the intended direction of the core curriculum combined with lower expectations of the reform's school-level impact compared to the members of *High coherence and impact* profile.
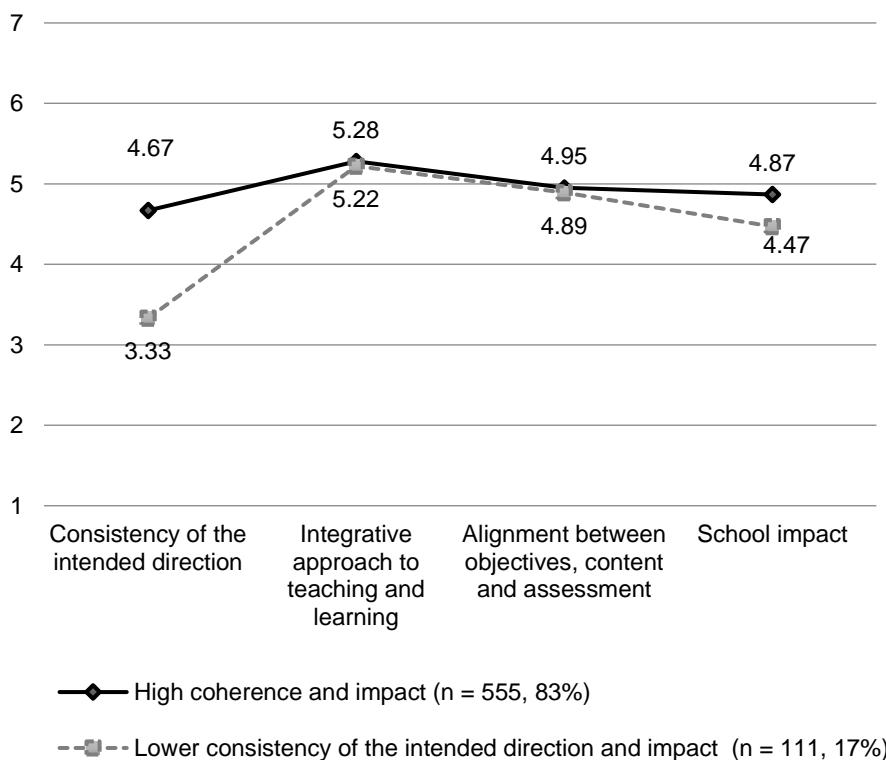
Figure 4. Profiles of perceived curriculum coherence and school impact among the state- and district-level stakeholders.

The two profiles did not differ regarding how the stakeholders in the profiles perceived the integrative approach to teaching and learning, for instance, how effectively the core curriculum facilitates active and engaging teaching methods and assessment that supports learning. Moreover, they did not differ in terms of perceiving the core curriculum as an aligned and continuous whole. The differences between the profiles were identified in the perceived consistency of the intended direction and school impact (see Figure 4). Hence, the *High coherence and impact* profile members had more positive perceptions of the extent to which the core curriculum provides a consistent direction for school development, for instance clarifying the roles of teachers and schools, and of how strongly the reform process facilitates engaging and active development work at the school level, compared to the *Lower consistency of the intended direction and impact* profile.

Further investigation showed that the state-level stakeholders had 4.22 times higher odds of being members of the *High coherence and impact* profile, and lower odds (Odds ratio = 0.24) of falling into the *Lower consistency of intended direction and impact* profile compared to their district-level counterparts. Accordingly, the state-level stakeholders, responsible for the development of the

national core curriculum, were relatively more likely to experience more balanced curriculum coherence in terms of the three elements and to evaluate the school impact of the reform stronger than the district-level stakeholders, who were responsible for constructing the local curriculum in the framework of the reformed core curriculum. Still, both profiles were shown to agree that the core curriculum is aligned and supports the integrative approach in teaching and learning.

5.3 Trajectories of teachers' perceived curriculum coherence

The individual variation in teachers' ($N = 901$) perceptions of curriculum coherence and the development of these perceptions was examined over a one-year follow-up during the early stages of curriculum implementation (research question 2). The results revealed five distinct profiles among the teachers (*study III*): 1) *High coherence*; 2) *High-moderate coherence*; 3) *Low-moderate coherence*; 4) *Decreasing coherence*; and 5) *Low coherence* (see Figure 5).
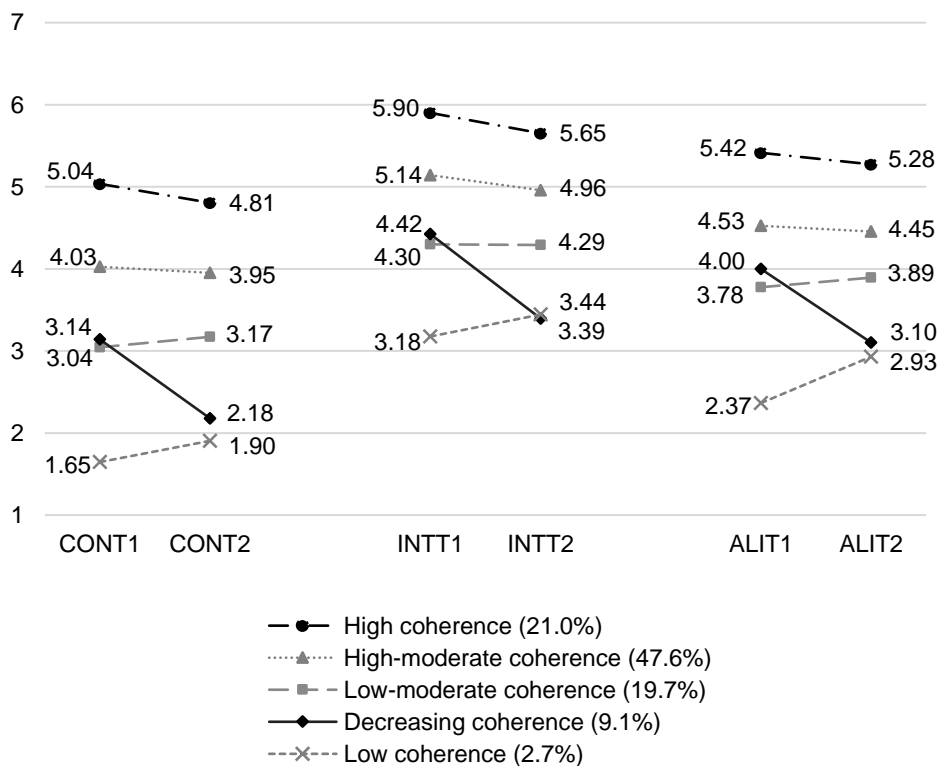

Figure 5. Teachers' profiles of perceived curriculum coherence based on the consistency of the intended direction (CON), the integrative approach to teaching and learning (INT), and alignment between objectives, content and assessment (ALI) measured at two time points.

Two of the more common profiles among the teachers were *High coherence* (21%) and *High-moderate coherence* (48%). Both were characterized by rather high or moderate levels of perceived curriculum coherence. The *High coherence* profile members perceived the core curriculum document to be coherent in terms of all three elements of coherence. In turn, teachers in the *High-moderate coherence* profile reported only moderate levels of the consistency of the intended direction, concerning for instance how successfully the core curriculum clarifies and supports the local work of schools and teachers, and facilitates teaching the essential subject matter. Teachers in these two profiles showed a slight statistically significant decrease in all three coherence elements during the one-year follow-up.

   Teachers in the *Low-moderate coherence* (20%) profile had quite mixed perceptions of the curriculum's coherence in terms of the integrative approach to teaching and learning, for instance supporting a novel approach to active and engaging learning, and the core curriculum's alignment, in terms of connections between the objectives, content, teaching methods and assessment (see Figure 5). They also scored the consistency of the intended direction as being rather low. Thus, teachers in the *Low-moderate coherence* profile did not perceive the new core curriculum as successfully delimiting the work of schools or to sum up their most important goals. Yet, these teachers' perceptions of the consistency of the intended direction and alignment within the curriculum increased slightly during the one-year follow-up in the early stages of the curriculum implementation.

   Teachers displayed the *Low coherence* (3%) and *Decreasing coherence* (9%) profiles less often (see Figure 5). Teachers in the *Low coherence* profile perceived all the elements of curriculum coherence, consistency of the intended direction; integrative approach to teaching and learning; and alignment between objectives, content, and assessment, to be low at both time points. However, their experiences of coherence after the one-year follow-up increased in terms of the consistency of the intended direction, i.e. the clarification and support for the work of teachers and schools, and in terms of the alignment and continuity within the curriculum. In turn, teachers in the *Decreasing coherence* profile showed the greatest decrease in their perceptions of curriculum coherence, with a statistically significant decrease in all the elements. They reported moderate or low curriculum coherence at the beginning of the implementation, and ended up with low experiences of curriculum coherence after the one-year follow-up.

5.4 The relation between curriculum coherence and school impact

The results showed that district-level stakeholders' ($N = 550$) perceptions of the core curriculum's coherence contributed strongly ($R^2 = .64$) to their expectations of the curriculum reform's impact on the school-level development (research

question 3; *study I*). Thus, highly coherent perceptions of the core curriculum document were related to perceiving the reform process to be highly influential in terms of promoting school development, for instance committing teachers to the development work, directing the development towards problems faced at schools, maintaining active development work, and facilitating the resolution of school-level problems (Figure 6).
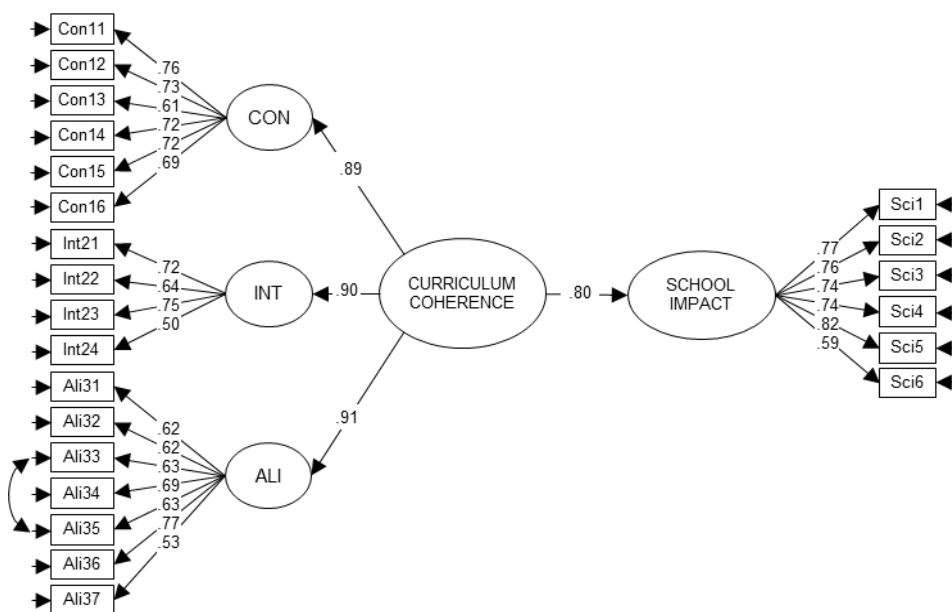
Figure 6. Curriculum coherence as a determinant of school impact. CON: consistency of the intended direction, INT: integrative approach to teaching and learning, ALI: alignment between objectives, content and assessment. Standardised model: $x^2(225) = 469.82$, $p < 0.001$; RMSEA = 0.044 (90% C.I. = .039–.050); CFI = .94; TLI = .93; SRMR = 0.043.

Examination of teachers' perceptions confirmed the result that coherent perceptions of the core curriculum were related to higher expectations of the reform's school impact. The investigation of teachers' curriculum coherence profiles provided a more detailed understanding of how the individual patterns of experienced coherence were connected to their expectations of the reform's impact on further school development (*study III*). The results were in line with the results of *study I,* showing that the more coherent the core curriculum was experienced within the profile, the higher were the perceptions of the school-level impact of the reform process (Table 6). Teachers in the *High coherence* profile, who perceived the core curriculum to be coherent in terms of all three elements, showed the highest expectations of the reform's effects on school development. In turn, teachers in the *Low coherence* profile, reporting low coherence in all elements, scored the school impact lowest. The *High-moderate coherence* profile members, with high perceptions of the core curriculum providing an integrative approach to teaching and learning and high perceived alignment within the

curriculum, also had higher perceptions of school impact than the *Low-moderate coherence* and *Decreasing coherence* groups, that had mixed or low experiences of coherence. The development of perceived curriculum coherence also seemed to reflect the development in the expectations of school impact. The *Decreasing coherence* profile members did not differ from the *Low-moderate coherence* profile in the perceived school impact at T1, but had lower expectations at T2, when their experiences of curriculum coherence had also dropped.

Table 6. School impact means, standard errors, and Chi-square values for the tests of equality of means across teacher profiles at Times 1 and 2.

Profiles	1. High coherence	2. High-moderate coherence	3. Low-moderate coherence	4. Decreasing coherence	5. Low coherence
T1: School impact					
M	5.42	4.58	3.75	3.76	2.53
SE	.06	.04	.07	.11	.21
1.	-				
2.	116.79	-			
3.	334.43	95.74	-		
4.	181.64	51.82	0.00^{ns}	-	
5.	171.80	90.40	29.41	26.60	-
T2: School impact					
M	5.26	4.40	3.83	2.82	2.81
SE	.06	.04	.06	.13	.26
1.	-				
2.	136.00	-			
3.	288.04	50.64	-		
4.	303.37	138.39	43.76	-	
5.	82.36	35.50	13.68	0.00^{ns}	-

^{ns} = non-significant p-value. All other Chi-square tests are significant at p < .01

5.5 Perceived curriculum coherence and school impact through the educational system

The educational stakeholders' experiences of the coherence of the core curriculum and the reform's impact on school development varied between the different levels of the educational system (research question 2). Overall, in terms of the sample mean scores it seemed that the level of perceived curriculum coherence and school impact decreased slightly as the reform process proceeded through the educational system (Figure 7). It should be noted that the sample mean scores of all cohorts were rather positive or close to the scale midpoint, and the observed differences were rather small. However, according to the results (see Appendix A) there were statistically significant differences. For instance, the state-level stakeholders perceived the core curriculum to be more coherent than the teachers, particularly regarding the consistency of the intended direction of the curriculum, regarding how well the core curriculum facilitates the local curricular work, teaching the essential, and clarifies the work of schools and teachers.

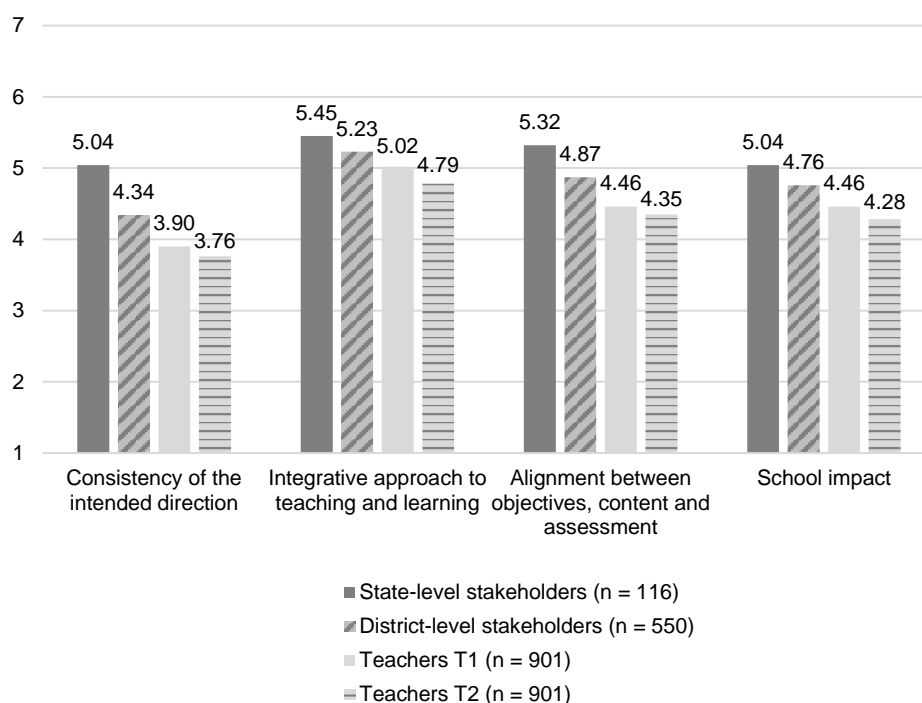**Figure 7.** Mean scores of perceived curriculum coherence and school impact in the three cohorts.

In general, the order of the scoring of the elements of curriculum coherence was similar in all cohorts (Figure 7). The reformed core curriculum was most strongly experienced as supporting the integrative approach to teaching and learning, i.e. to provide a novel approach to promote activating and engaging teaching methods

and assessment to support learning. However, compared with the other elements of curriculum coherence, the state- and district-level stakeholders and teachers agreed least on the consistency of the direction in which the core curriculum was aimed, such as how successfully the curriculum sums up the main aims and supports the work of teachers and schools.

5.6 Summary of the main findings

In this dissertation, educational stakeholders' perceptions of curriculum coherence in the context of a national curriculum reform in Finland have been explored. Curriculum coherence was found to be comprised of three complementary elements: consistency of the intended direction, integrative approach to teaching and learning, and alignment between objectives, content and assessment (research question 1; *study I*).

The educational stakeholders' experiences of the curriculum's coherence varied between and within the levels of the educational system (research question 2). Overall, the experienced curriculum coherence seemed to decrease slightly as the curriculum reform process proceeded through the levels of the educational system; the state-level stakeholders had the most positive and teachers the least positive perceptions of curriculum coherence and school impact. Moreover, the state-level stakeholders were relatively more likely to show positive perceptions of the core curriculum's coherence in all three elements as well as to expect the reform process to have an impact on school-level development, whereas the district-level stakeholders were relatively more likely to belong to a profile that had lower perceptions of the consistency of the intended direction of the curriculum, combined with slightly lower expectations of the school impact of the reform (*study II*). Among teachers, five distinct profiles were detected based on perceived curriculum coherence and its development over a one-year follow-up during the early stages of implementing the curriculum at schools (*study III*). The profiles with the highest perceived curriculum coherence were the largest and showed a slight decrease in the experienced coherence during the follow-up, whereas two profiles with low and moderate perceptions showed increasing patterns. Finally, the *Decreasing coherence* profile showed a relatively large drop in perceived curriculum coherence. Although the overall perceptions of coherence by teachers seemed to decrease during the first year of implementing the curriculum at schools, the person-centered approach allowed the identification of subgroups of teachers with different trajectories of experienced curriculum coherence.

Curriculum coherence was found to be related to the stakeholders' expectations of the reform's impact on school-level development in terms of supporting locally functional development and maintaining active development work in schools (research question 3; *studies I* and *III*). The more the core

curriculum was experienced to provide coherence in terms of the three elements, the more effective the reform process was evaluated to be for the further development work at the school-level (*study I*). In line with this, teacher profiles also differed in their perceived school impact; the profiles with highest perceptions of curriculum coherence also had the highest beliefs of the reform's potential effects on school development (*study III*).

6 Discussion

6.1 Methodological reflection

Considering *the research design*, the systemic design was utilised in order to explore educational stakeholders' perceptions of curriculum coherence in the context of the Finnish core curriculum reform. Having data from three levels of the educational system, collected so that the timing followed the curriculum development process through the levels, is a major strength of the study. It allowed the examination of how curriculum coherence throughout the reform process was experienced. On the other hand, the distinctive characteristics of the Finnish educational system, such as the autonomy in the development of local curriculum and school practice, limit the generalizability of the findings. Moreover, based on the cross-sectional data, causal inferences can not be made about the relationships between variables. While the data from teachers was longitudinal, the focus of the analysis was on individual response patterns. The longitudinal aspect in the development of teachers' perceptions of curriculum coherence during the early stages of curriculum implementation was taken into account by including two measurements of each element of curriculum coherence as profile indicators (*study III*). The latent profiles were compared in terms of perceived school impact, which at the same time validated the profile model and confirmed the relationship between curriculum coherence and school impact. However, more measurements would be needed in order to examine the development of educational stakeholders' perceptions more closely with other longitudinal analysis methods such as latent growth modeling.

Regarding *the participants*, three cohorts representing different roles in the reform process were included. The data sets were relatively large and the samples represented the central stakeholders in the curriculum reform process sufficiently well. The data were collected as part of fieldwork and the participants were informed and had the opportunity to discuss the research project. It should be noted that the state- and district-level stakeholders were individuals that were invited or signed up in the state- and district-level curriculum development working groups. Thus, they might represent individuals with a more open or active approach to the development work than on average. Their perceptions of the core curriculum and the reform process might also be related to the fact that they have been involved in various developmental activities in the curriculum development work. For instance, participation in curriculum design at the local level has been shown to be related to increased knowledge and interest in the curriculum (Atjonen, 1993; Salminen & Annevirta, 2016). Thus, it might be that the various experiences of coherence arise from the amount or quality of learning activity in curriculum development work. However, the working groups did involve a large

range of educational experts, stakeholders, teachers and other school staff from a variety of roles. The teachers' longitudinal data, in turn, included teachers from case schools that represented variations in terms of region and school size. The data included teachers who were identified as having responded at both time points (*study III*). Thus, the responses might not represent the perceptions of teachers who might have left the profession, for instance. Some of the attrition, however, was due to teachers moving to work outside the case schools, retiring or providing unidentifiable responses. For the person-centered analysis, the complete cases analysis was considered to be appropriate.

In terms of *the procedures and measures*, the study utilized self-reported survey data, which is known to be susceptible to certain biases, such as common method variance (Podsakoff, MacKenzie, Lee & Podsakoff, 2003) and social desirability bias (Nederhof, 1985). Common method variance might have partly influenced the relation between perceived curriculum coherence and school impact that were both measured by the same survey and the same scale format. However, the validity and distinctiveness of the scales were examined with CFA and analysis of the average variance extracted (*study I*) and was considered adequate. Moreover, the aim of this study was to explore curriculum coherence from the perspective of educational stakeholders at different levels of the educational system. Hence, self-report surveys were the best way to gain information on the different-level stakeholders' perceptions on a large scale, allowing for the research design to be adapted to the systemic reform. The large data sets and the timing of data collection according to the curriculum reform process are also a major strength of the study. Nevertheless, in the future it would be useful to examine the relationship between curriculum coherence and school impact in more detail by combining different methods.

In terms of *the operationalization*, the curriculum coherence instrument provides a novel tool to examine coherence from the perspective of educational stakeholders that are involved in developing and implementing curriculum reforms. The instrument was shown to function well in measuring these perceptions at the different levels of the educational system. It should be noted, however, that with the measures used, it is not possible to know *how* the educational stakeholders have understood and interpreted the core curriculum in terms of the content of their understandings. It might be that the participants understood the core curriculum in different ways regardless of the intended meaning of the curriculum (see Spillane et al., 2002). Thus, perceived curriculum coherence throughout the levels does not necessarily imply that the different stakeholders have the same understandings of the core curriculum's aim and content. In addition to the core curriculum document, educational stakeholders come to understand the curriculum through discussions, professional meetings and other publications. Moreover, teachers' pre-existing beliefs and the extent of processing the curriculum may have varied and influenced their perceptions of

coherence within the new curriculum. However, the study focused on the importance of constructing a sense of coherence about the curriculum, regardless of possible variations in the content of these understandings. In fact, some variation in teachers' understandings should be expected to occur in the Finnish context, because the top-down-bottom-up implementation strategy promotes the autonomy of schools and teachers in considering the local and contextual factors in the curriculum development process (see Pietarinen et al., 2017; Vitikka et al., 2016).

In terms of the measurement invariance between participant cohorts and measurement points, scalar invariance between teachers' responses at two time points (*study III*) was established, meaning that the scales consistently measured the same constructs over time. Between the state- and district-level stakeholders, partial scalar invariance was established with a few non-invariant intercepts in the scales (*study II*). Although the invariance of most items has been suggested adequate (e.g. Byrne et al., 1989; Steenkamp & Baumgartner, 1998), it has also been questioned whether partial invariance is sufficient (Steinmetz, 2013). The few non-invariant intercepts might represent some systematic differences or biases in the response levels between the state- and district-level stakeholders in these items, partly affecting the results. However, only a minor number of the intercepts within the scales were non-invariant.

In terms of *the methods*, this dissertation combined variable-centered and person-centered approaches in order to gain a comprehensive understanding on educational stakeholders' perceptions of the core curriculum's coherence. Variable-centered methods were utilised to examine the anatomy of perceived curriculum coherence and its relation to the expected school-level impact of the reform process. Person-centered methods allowed for the differences and similarities of individuals' response patterns to be focussed on, identifying subgroups based on patterns of educational stakeholders' perceptions (Berlin et al., 2014). The person-centered analyses revealed a more complex understanding about the variation in the perceived curriculum coherence within and between the levels of the educational system. This approach was particularly suitable with the large-scale survey design, since variable-centered methods alone could have provided a rather over-generalized description of the large data sets of heterogenous stakeholder groups that were shown to include subgroups with differing views on the core curriculum and the reform process. Nonetheless, a challenge with latent profile analysis is that it does not provide an unambigous way to decide on the number of identified profiles (Nylund et al., 2007). The choices of the latent profile models were based on various statistical indicators, number of cases in each profile, parsimony and interpretability. Yet, the number of profiles could vary with different data sets and in different contexts. However, the latent profile analysis provided a descriptive account of the individual variation in the perceptions of educational stakeholders who were involved in

different phases of the national curriculum reform. Overall, the combination of variable- and person-centered methods provided an understanding of both the relations between variables as well as individual and between-level variation in educational stakeholders' perceived curriculum coherence.

The validity and *reliability* of the study were examined with multiple indicators. The confirmatory factor analysis showed that the measurement models for curriculum coherence and school impact fit each data set sufficiently well. More specifically, the convergent validity of the scales was sufficient in terms of factor loadings (Hair et al., 2014) and item reliabilities, examined with squared multiple correlations (*study I*). Moreover, the reliability of the scales was consistent in terms of the construct reliability values and factor determinacies (*study I*), as well as Cronbach's alphas in all original studies (Hair et al., 2014). Discriminant validity in terms of distinctiveness between the school impact scale concerning the effects of the reform process, and the curriculum coherence scale concerning the coherence within the core curriculum document, was examined by comparing the square root of the average variance extracted from each construct with the correlations between the different constructs (Hair et al., 2014). Discriminant validity was supported between each subscale of curriculum coherence and school impact, whereas the distinctiveness between the alignment factor and the other two factors of curriculum coherence was not supported by this test (*study I*). However, the three-factor model was supported by the CFA over the one-factor model, and these factors were expected to be part of the same second-order latent construct of curriculum coherence.

In terms of content validity, the curriculum coherence scale included items with a broad range of content, since the measured latent construct of curriculum coherence is complex and did not have a well-established definition in the previous literature. The curriculum coherence scale is also a new measure and the three-factor structure of the scale was confirmed in *study I* for the first time. Thus, the number of items facilitated the coverage of the construct. Further examination of the scales with different samples is needed, as well as validation of the scales in other contexts and languages. Validation should also include adaptation to the local context, as the scales might need editing depending on national policies.

Overall, the validity and reliability of the study was considered to be sufficient with respect to the research questions – to explore the educational stakeholders' perceptions of the coherence of the reformed core curriculum, variation between and within levels, and relation with the expected school impact of the reform. The construct validity of the curriculum coherence and school impact scales was supported, however more research is needed to examine whether the measures are valid and reliable in other contexts. In sum, the study provides a comprehensive examination of perceived curriculum coherence in large-scale curriculum reform by including data from three levels of the educational system, and by combining the variable-centered and person-centered analytical approaches.

6.2 Research ethics

The study was conducted following the guidelines for responsible conduct of research and the ethical principles of research in the humanities and social and behavioural sciences by the Finnish Advisory Board on Research Integrity (2009, 2012). Before data collection, research consent was acquired from the Finnish National Agency for Education, municipalities, and schools. Participation in the research was voluntary and based on informed consent. The participants were informed about the research project, the purpose of the research, scope of the survey, estimated time required, and data management, before their participation. Data were collected as part of fieldwork and the participants had the opportunity to ask for more information about the research project. To protect the privacy of the participants, responses were anonymous and in the case of the longitudinal data, the identifiers were removed for data analysis. The participant groups were also informed about the results of the research project. In the research process the principles of integrity, meticulousness and accuracy have been followed. The methods and results of this dissertation have been reported and described with respect to openness and accuracy.

6.3 Main findings in light of previous research

This study contributes to the literature on curriculum reform by examining the anatomy of curriculum coherence as perceived by educational stakeholders. The results suggested it is an important determinant for sustainable school development. Coherence making requires constructing shared and coherent understandings of the curriculum as an object and tool for school development. Curriculum coherence was found to include clarity about the consistent direction of the curriculum, an integrative approach on the development of teaching and learning, as well as alignment and continuity between the curriculum's elements. The results showed that the more the curriculum is perceived to be coherent in terms of these three elements, the more positive the impact of the reform is expected to be on locally functional school development work. The results also imply that the recent Finnish national core curriculum has been experienced to be rather coherent, and to fit the local practice of schools and teachers in terms of perceived school impact. Yet, there were differences in the perceptions within and between the levels of the educational system.

Conceptual contribution
This dissertation contributes to the research on curriculum reform by providing a model of curriculum coherence. It has been previously suggested that coherence is an important curriculum design principle and a determinant for school development (e.g. Beane, 1995; Newmann et al., 2001). However, coherence has been defined and operationalized in multiple ways and examined at various levels

such as between system-level policies, in school-level instructional programs, and in subject curriculum. In the main, previous studies on curriculum coherence have explored it as an actual feature of the written curriculum and analysed the alignment or sequencing between the elements of the curriculum. This study contributes to the literature on curriculum reform by examining coherence as a subjective attribute (Century & Cassata, 2016), perceived by the educational stakeholders who are responsible for developing curriculum and practice at the various levels of the educational system. This perspective considers the implementation process by examining perceptions of key stakeholders in accordance with the timeline of the reform process, while focusing on the reformed national core curriculum as the object of the coherence making and development work. Thus, the approach utilised in the dissertation combines the innovation and implementation perspectives on curriculum reform (Knapp, 1997).

The study contributes to the literature on coherence by providing a model of curriculum coherence that draws on various conceptualizations that have emphasized clear goals, shared vision and purpose, focus on improving teaching and learning, consistency between policies, as well as aligned, integrative and progressing curriculum design (e.g. Cohen & Spillane, 1993; Fortus et al., 2015; Fullan, 2007; Fullan & Quinn, 2016; Newmann et al., 2001; Schmidt et al., 2005; Smith & O´Day, 1991). The three elements of curriculum coherence draw on these aspects and are examined from the perspective of those who matter most for school practice – educational stakeholders (Darling-Hammond, 1998; Fullan, 1996). Accordingly, the study advances the understanding of the anatomy of perceived curriculum coherence.

The findings indicated that perceived curriculum coherence consists of three complementary elements: consistency of the intended direction, an integrative approach to teaching and learning, and alignment between objectives, content and assessment. Firstly, a coherent curriculum has a consistent direction that clarifies the mission of teachers and schools and summarizes the most important goals in a relevant way. This finding relates to previous research suggesting that focusing on clear educational goals is essential in building coherence in educational systems (e.g. Newmann et al., 2001; Smith & O'Day, 1991), and that a shared vision and holistic understanding of the goals of the reform are crucial for local commitment to the reform (e.g. Pyhältö et al., 2014; Reezigt & Creemers, 2005). Secondly, curriculum coherence entails an integrative approach to teaching and learning that aims to develop the core of schooling in a harmonised way, supporting active and engaging learning as well as assessment methods that support learning. Accordingly, this element reflects the aims of the new core curriculum that emphasizes harmonization of learning and integration of teaching across subjects (Finnish National Board of Education, 2014). The integrative approach to teaching and learning also relates to studies suggesting that clear principles and values of the core practices of teaching and learning, which fit the

phase of pedagogical development in schools, are essential for school improvement (e.g. Elmore, 1996; Newmann et al., 2001). Thirdly, a coherent curriculum shows alignment between the objectives, content, teaching methods and assessment. Alignment and sequencing of the curriculum have previously been shown to be associated with pupil achievement (e.g. Fortus et al., 2015; Schmidt et al., 2005; Shwartz et al., 2008; Squires, 2009) and the results of this study complement the literature by showing that alignment is also crucial for those interpreting and using the curriculum. The study complements the research on the importance of subjective alignment, which has previously been studied in the context of teachers' professional development programs (e.g. Allen & Penuel, 2015; Penuel et al., 2007).

The results showed that the three elements of curriculum coherence are strongly related to each other. Thus, coherence making should focus on all three elements simultaneously. A coherent curriculum without consistency in the intended direction might lack a shared long-term purpose that guides the everyday work of schools and makes the change meaningful for individuals and professional communities. In turn, the integrative approach to teaching and learning is important in stating what development phase in terms of teaching and learning is required in order to reach the goals of the curriculum. Finally, without alignment between the curriculum's elements, the meaning of the curriculum will not likely make sense to either teachers or pupils, which may cause perceived fragmentation or contradiction. Based on this conceptualization, the study also provides a novel analytical tool for examining curriculum coherence, which did not have a well-established definition in the previous literature. The structure of the scale was supported with each of the cross-sectional and longitudinal data sets. Yet, the scale should also be further studied and developed.

Curriculum coherence in relation to school impact of the reform

Considering the theory of school development, an important contribution of the study is shedding light on the relation between perceived curriculum coherence and the impact of the reform on further school-level development. Thus, the study also creates a linkage between curriculum studies and school development, by examining an attribute of the curriculum document in relation to how the curriculum reform is expected to act as a functional framework for school development work.

It has previously been shown that teachers' and school communities' interpretations and understandings of the change are connected to their intentions to translate the changes into practice and their ownership of the reform (e.g. Louis et al., 2005; Penuel et al., 2007; Yildirim & Kasapoglu, 2015). Accordingly, this study showed that perceptions of curriculum coherence were strongly connected to district-level stakeholders' beliefs about the potential effects of the reform work

on the school-level development of practice (*study I*), in terms of resolving challenges in local school practice and committing teachers to working on developing the school. This implies that curriculum coherence promotes coherent thinking about the development of practice. Moreover, teachers' perceptions of curriculum coherence were connected to the expected school impact of the reform process, as the five curriculum coherence profiles identified in *study III* differed in perceived potential impact of the reform process. In general, the more coherent the core curriculum was perceived to be in the profile, the more positive were the expectations of the reform's impact.

The positive relationship that was found between perceived curriculum coherence and potential school impact might reflect a successful process of translating the reformed core curriculum into the local context through coherence making. In other words, whether a reformed curriculum is considered to fit the local school development depends on the educational stakeholders' judgments about its coherence, as well as on its congruence with their other beliefs, values and professional experiences (see e.g. Donnell & Gettinger, 2015; Penuel et al., 2007). Constructing a coherent understanding on the goals and principles of changing teaching and learning in the context of a reform that aims to reach the classroom practice is a prerequisite for creating a consistent way of thinking for the stakeholders. This may further enable coherent school development and eventually lead to more coherent learning experiences for pupils, if the requirements of the coherent curriculum are also experienced to fit the local capacity of schools and teachers. It seems that in the case of the Finnish core curriculum reform of 2014, the core curriculum was perceived as being sufficiently coherent to fit the local school development, as the relation between curriculum coherence and school impact was strong. In sum, continous coherence making in the context of national curriculum reform is crucial in order to increase the local functionality of the development work, to mediate reform ownership from level to level and to sustain the change effort over time.

However, it should be taken into account that causality can not be inferred based on the data and methods used in this study. Positive expectations about the impact of the reform process can also promote perceptions of curriculum coherence. Moreover, curriculum implementation had not yet started in schools when the data from the state and district levels were being collected. Hence, the perceived school impact represents the stakeholders' expectations about the upcoming school level development. However, educational stakeholders' positive expectations and beliefs about the reform's impact can be assumed to reflect their behavioural intentions and ownership over the curriculum enactment in practice.

Coherence making throughout the large-scale reform
The research presented in this dissertation contributes to the broader research on large-scale reform by suggesting that coherence making is crucial within and

between the levels of the educational system in order to mediate curriculum coherence from the national level to the local level and finally to the level of classroom practice. The perceived curriculum coherence examined in this study is considered to reflect the outcome of the coherence making process and understanding of the object of the school development work at each level of the educational system. Educational stakeholders' and teachers' active sensemaking has been shown to be an important part of curriculum implementation (Spillane et al., 2002). The results suggest that a central aim should be the construction of *coherent* understandings of the curriculum through various sensemaking activities since coherent perceptions were related to the expected school impact. A curriculum that is interpreted as coherent may further promote implementation by supporting locally functional development work and broad commitment to it (see also Fullan, 1996; Penuel et al., 2007). In turn, experiences of discrepancy or contradictions within the curriculum may act as obstacles in the process of coherence making while the reform is mediated through the educational system (see e.g. Ng, 2009; Russell & Bray, 2013; Smith & Southerland, 2007).

The dissertation went beyond the part studies in examining the complexity of perceived curriculum coherence between the levels of the educational system. According to the results, all stakeholders on average perceived the new core curriculum to be relatively coherent and to have potential impact on school-level development. Yet, the results showed that educational stakeholders' perceptions of both the curriculum's coherence and the reform's school-level impact were less positive when proceeding from the state-level curriculum development to the district-level curriculum work and finally to the level of schools and teachers. This might imply that some challenges were identified in the district-level curriculum work, in which the core curriculum is interpreted and translated with regards to the local needs and resources, and even more so in the enactment of the curriculum by teachers, whose aim is to integrate the principles of the curriculum into their everyday work and fit them to the needs of their pupils.

Hence, the complexity of the coherence making process might increase at the local and school levels, in which the demands and challenges of the development work might be seen in more practical terms in relation to school practice. Thus, the relevance and funtionality of the curriculum might not be tested until the school practice. Previous studies have also shown differences between the levels of the educational system in how the stakeholders and practitioners understand and agree with reforms (e.g. Wong & Cheung, 2009), and some of the variation might be due to the role of the stakeholders in the reform process (Desimone, 2006).

More specifically, coherence making seems to have facilitated some elements of curriculum coherence more efficiently than others. Throughout the levels of the educational system, consistency of the intended direction of the core curriculum was perceived to be the least successful element of curriculum coherence, while

the integrative approach to teaching and learning was perceived to be the strongest element. Moreover, in *study II* the perceptions of coherence were similar between the profiles of state- and district-level stakeholders in terms of the integrative approach to teaching and learning and alignment and continuity within the curriculum. This agreement may have provided an important resource for further curriculum development by establishing a common ground for the development work.

However, there were differing views between the profiles on the intended direction of the core curriculum and different expectations of the school-level impact of the reform. Some of the teacher profiles also had rather low perceptions of the consistency of the intended direction. On one hand, this could imply that the intended direction of the core curriculum has not been as clearly defined or communicated as the approach to teaching and learning, or that there was less agreement among the local educational stakeholders on the intended direction of the curriculum. On the other hand, it could mean that constructing coherence in terms of the practical aspects of the curriculum, focusing on how to transform teaching and learning, is more likely to become a tangible element in the daily school practice. In contrast, agreeing on the intended direction, i.e. the rationale for the curriculum, might require intentional reflection and long-term perspective into the change process to construct an understanding regarding how the curriculum supports the roles of schools and teachers and facilitates the teaching of the most essential content. It has been suggested that understanding the big picture and underlying purpose of the curriculum is important for local engagement with the reform (see e.g. Cheung & Wong, 2011, Coburn, 2003). Hence, the variation identified in the agreement with the direction of the curriculum might result in challenges in terms of achieving sufficiently shared understandings throughout the educational system.

The person-centered analyses utilized in this study provided a more detailed understanding of perceived curriculum coherence and school impact across the levels of the educational system. Based on individual response patterns, two distinct profiles of the combined data of state- and district-level stakeholders were identified (*study II*), and five profiles with various levels of perceived curriculum coherence and different developments of these perceptions over a one-year follow-up were found among teachers (*study III*). The district-level stakeholders were relatively more likely to belong to the profile that perceived the consistency of the intended direction of the curriculum and the school impact of the reform as less successful, when compared to the state-level stakeholders. A previous study also showed that the state-level stakeholders in charge of the recent core curriculum development process had a consensual view of the curriculum process (Salonen-Hakomäki et al., 2016).

The state-level stakeholders' role in constructing the core curriculum presumably involves broad discussion and negotiation around the aims of the

reform, which might explain that they have processed the direction of the reform rather deeply and reached positive and shared perspectives as a result of the development work. On the other hand, the state-level stakeholders might have fewer opportunities to reflect on the curriculum changes in relation to school practice. District-level stakeholders, in turn, are involved in the construction of local curriculum in which they need to combine the intentions of the national core curriculum, a published document, with the realities, resources and needs in their local settings. Accordingly, their role in the curriculum reform involves making sense of the core curriculum by evaluating it against the previous curriculum and other local policies and experiences, identifying the required changes and adapting the goals into activities at the school level (Soini et al., 2018). Thus, their attention might be focused on different issues and more practical aspects than those emphasized by the state-level working groups in their work.

In terms of the teachers, five distinct profiles of perceived curriculum coherence were identified in the early stages of the curriculum implementation. Teachers who perceived the highest curriculum coherence at the beginning of the implementation had a slightly decreased experience of coherence after the first year. In turn, teachers starting with lower experiences of coherence slightly increased their perceptions of the core curriculum's coherence, while a small group of teachers had a large drop in perceived curriculum coherence even after starting with a low experience of coherence. The results imply that perceptions of curriculum coherence develop while the curriculum is implemented and thus, practice and experience can interact with coherence making (see Bliss & Wanless, 2018; Spillane et al., 2002). On one hand, experimentation in school practice might cause a reality check, revealing incongruities or contradictions in teachers' understanding. Moreover, teachers might see the demands of the development work more clearly when starting to enact the curriculum in practice. On the other hand, it might result in successful experiences in which the curriculum is experienced as fitting the needs of pupils or to make more sense through practice, which contributes to coherence in the interpreted curriculum. This is in line with what has been suggested regarding visions and understandings, that they can also advance after developing practice (Fullan, 1993; Spillane et al., 2002). However, the study showed that most of the changes in perceived curriculum coherence during the early stages of implementation were small. It could be that the one-year time frame is not enough to show large changes to teachers' initial interpretations of the curriculum. On the other hand, it could imply that teachers have already constructed certain interpretations about the curriculum during the curriculum development work and that the beginning of implementation in practice has not caused large changes in most teachers' understanding. Yet, studies on the development of perceived curriculum coherence over longer time frames are needed.

To examine whether the school context is connected to teachers' perceptions of curriculum coherence, the school-level variation was examined as an initial analysis in *study III*. The results were in line with some previous studies that found small school-level variation in teachers' perceptions regarding reform implementation (e.g. McCormick et al., 2006), implying that teachers' perceptions of curriculum coherence are largely individual. This could mean that the school has a quite small influence on the extent to which teachers construct a coherent understanding of the national core curriculum. However, the school-level variation in teachers' perceptions of the consistency of the intended direction was considerable as it increased during the early stages of curriculum implementation, being 13 percent after the first year of implementation. School-level factors, such as leadership, have previously been shown to affect school reforms and curriculum implementation (e.g. Priestley, 2011; Spillane et al., 2004; Thoonen et al., 2012) and thus, the school could influence collective coherence making. The results might imply that regarding the element of coherence that was least agreed upon throughout the reform process, i.e. consistency of the intended direction, the school might have a larger role over time. Schools as professional communities might differ in terms of the extent to which they continue to put effort into constructing shared understandings about the direction of the curriculum even after the implementation phase has begun, and how they support the long-term vision of the change in the everyday life of the school.

Altogether, the results of this study propose that both the individual and collective processes of coherence making are important in the reform process. Previous research on educational change has also emphasized both the role of the individual as a sensemaker, as well as the role that interaction of the social and institutional context have in influencing individuals' processes of understanding (see Spillane et al., 2002). This dissertation found individual variations in state- and district-level stakeholders' and teachers' perceptions of curriculum reform, however, there were also group-level differences between the levels of the educational system. Based on the results reported in this dissertation, it is proposed that individual and collective perceived curriculum coherence by educational stakeholders is central for the impact of curriculum reform on sustainable school development. At its best, shared subjective coherence could facilitate not only collective ownership of the curriculum reform throughout the system but also direct the school-level development work towards creating solutions that fit local goals and needs.

Overall, the results of this dissertation imply that coherence making is object-oriented, individual, dynamic, and relational. Firstly, curriculum coherence is directed at a certain object as it is experienced regarding the representations of the curriculum and thus relates to the characteristics of the formal, intended curriculum. Secondly, the results showed that among the educational stakeholders, various patterns of perceived curriculum coherence could be

identified. Thus, coherence making is individual, linked to individuals' knowledge, beliefs, experience and practice. Thirdly, curriculum coherence is dynamic, requiring continuous coherence making. The five distinctive trajectories in teachers' perceived curriculum coherence over the early stages of curriculum implementation imply that coherence is an interactive process that develops in continous interaction between the individual, context and practice (see also Honig & Hatch, 2004). Fourthly, curriculum coherence is relational in terms of the influence of the social and institutional context. It involves interaction, collaboration and negotiation within and between the levels of the educational system (see also Letschert & Kessels, 2003). For instance, the element of coherence that was perceived as the least successful by the state-level stakeholders involved in the construction of the core curriculum seemed to be even less agreed on among the teachers that were beginning to implement the curriculum. This could imply that the strengths and weaknesses in coherence making are mediated between the levels of the educational system along with the change process.

6.4 Implications for large-scale curriculum reform

Some implications for designing and managing large-scale curriculum reform can be proposed based on the results. Firstly, in curriculum design, effort should be invested in developing a consistent and aligned curriculum document that establishes a clear foundation for the construction of coherent understandings by those involved in interpreting the curriculum and transforming it into practice. Thus, curriculum design could take into account criteria relevant to each element of curriculum coherence. The results imply that investing efforts into building curriculum coherence is worthwhile in terms of further school development.

Secondly, this study introduced a novel instrument for examining perceptions of curriculum coherence, which could provide a basis for an analytical tool for evaluating the perceptions of different stakeholders in various phases of the reform process. The curriculum coherence scale allows administrators, leaders and researchers to examine whether the curriculum provides educational stakeholders opportunities to construct a holistic interpretation and reflect on the changes that are needed. Thus, it could allow building evidence-based and targeted forms of development and support. When perceptions of various stakeholder groups are made explicit and brought into discussion, efforts can be better targeted at continous construction of shared goals, commitment and consensus over the curriculum development (Letschert & Kessels, 2003). At the national level, perceptions of the curriculum and expectations for the reform's impact by all important stakeholder groups could be evaluated in various phases. This could contribute to decisions to adapt the curriculum or to provide targeted forms of support and professional development at district or school-level. At the local level, municipalities or schools could also continuously self-evaluate and

acknowledge their own stage in the reform process, reviewing the perceptions of the local stakeholders in order to guide the professional development towards key issues, to give feedback, and to provide better support for the school staff's individual needs. Yet, it is important to note that curriculum coherence does not imply that all teachers and schools should interpret and enact the curriculum in the exact same form. Rather, fit between national guidelines providing system coherence, and coherence in the interpretations of local stakeholders and teachers should be sought.

Thirdly, the study implies that at each level of the system, it is important to direct the curriculum development work and sensemaking process towards the issues that are relevant for the three components of coherence: consistency of the intended direction, integrative approach to teaching and learning, and alignment between objectives, content and assessment. Coherence making could be supported by acknowledging and building structural connections, integration and continuity within the curriculum, as well as by discussing the long-term direction of the school and the potential benefits of the reform collectively in the professional communities.

Fourthly, coherence making should be promoted at all levels of the educational system and especially between them. Continously facilitating and supporting active coherence making among stakeholders in the curriculum development process might promote utilizing the curriculum as a tool to work on school-level challenges and increase commitment to developing the school practice. Moreover, working on the initial vision and direction of the curriculum reform should be conducted in collaboration by those at the various levels of the system (Fullan, 1996), thus negotiating the long-term purpose of the reform with the stakeholders involved. Strategies and resources also need to be developed to facilitate local districts' and teachers' opportunities for coherence making. In schools, resources should be allocated for collective coherence making. It should be identified that coherence is not self-evident, but requires work and follow-up. For sustainable change in educational stakeholders' thinking, the coherence making process also requires time, opportunities and multilevel support in order for the individuals and professional communities to question, analyze, reflect on, discuss and develop their beliefs and practices (Coburn, 2001, 2003; Darling-Hammond, 1998; Datnow & Stringfield, 2000; Kohonen, 2001; Manouchehri & Goodman, 1998; Morris et al., 2000). The results imply that working on coherence through the educational system could have positive effects such as maintaining active development work and directing it towards solving problems faced at schools.

Finally, implications regarding professional development are also suggested. It has previously been shown that professional development, including teachers' inservice training and various support activities, are crucial for successful reform implementation (see Fullan & Pomfret, 1977; Penuel et al., 2007). Previous literature has shown that deliberate, organized and collaborative forms of

professional development can facilitate educational practitioners' learning, self-efficacy and agency, for instance (e.g. Bakkenes et al., 2010; Butler et al., 2015). In order to increase capacity for coherence making, teachers and other educational stakeholders should be trained to engage in curriculum development work in different forms and to integrate the curriculum and its development into the local planning of teaching and leaning (Salminen, 2018). Moreover, the results of this study contribute to this understanding by suggesting that variations between individuals should be taken into account. The results support previous findings suggesting that the needs of individual teachers may differ according to their previous experiences and beliefs, for instance (McCormick et al., 2006; O'Sullivan et al., 2008). As different profiles of perceived curriculum coherence were identified, the results imply that educational stakeholders might also need different kinds of support in coherence making. Some might need more time for individual reflection and planning concerning the curriculum and its implications, while others may benefit from opportunities to collaborate and discuss the issues with colleagues during experimentation and implementation (see also Sahlberg, 1996). For instance, to support coherence making regarding a consistent direction, broad discussion and negotiation on the issues related to the curriculum's direction and purpose might be needed. In turn, perceived alignment could be facilitated by collective mapping aiming to build structural connections and continuity among objectives, content and assessment in subject or classroom level teams.

Moreover, the fit between individual needs and opportunities for professional development should be continously evaluated and adjusted (see also Choi & Walker, 2018) since perceived coherence and school impact may develop in various ways during the early phase of curriculum implementation. Hence, providing educational stakeholders with various forms of professional development continously, and adjusting these options after the implementation has started, could suit the needs of individuals with different paths of coherence making. However, further research is needed to gain more information on the connections between professional development activities and perceived curriculum coherence.

6.5 Future research

This study explored perceived curriculum coherence in large-scale curriculum reform using a systemic quantitative research design. The large quantitative data sets allowed for an examination of the anatomy and function of perceived curriculum coherence with responses from three different groups of educational stakeholders. Thus, the quantitative research design was suitable for this kind of large-scale exploration of educational stakeholders' experiences of curriculum coherence. However, exploring perceived curriculum coherence in more depth, for instance by interviewing stakeholders who have different views on curriculum

coherence, would add to the understanding of the concept. Further research is also needed to examine whether educational stakeholders use different or similar strategies and activities in coherence making in the context of curriculum development. Moreover, it would be important to continue follow-up research on how the curriculum coherence experienced and school impact develop over several years while the curriculum is enacted and further developed in practice.

This study presented an examination of the relationship between curriculum coherence and school impact in terms of the educational stakeholders' expectations of the potential of the reform process to trigger locally functional development work at the school-level. Future research should also examine how curriculum coherence perceived at the individual or school-level relates to actual changes in the practice of schools, and more importantly, in pupils' learning outcomes and wellbeing over time. Moreover, further research is needed to investigate how much perceived coherence and agreement across levels of the educational system is possible and necessary for the reform to have a positive impact on school-level development. Gaining an understanding of how coherence making could be effectively supported and facilitated throughout the process and at different levels of large-scale curriculum reform would also be an important aim for future research.

As the participant cohorts in this study were involved in different roles in the curriculum development work, further research is needed to examine the role of other variables, such as the amount of participation in curriculum development activities, which might have influenced the perceived curriculum coherence. In addition, it would be useful to examine the perceived curriculum coherence in relation to other determinants interacting in the curriculum reform process, such as local change leadership, strategies and resources, as well as individual variables such as openness to change, previous experiences of change, experienced agency, and beliefs and values regarding teaching and learning. This would add to the understanding of how perceived coherence of the curriculum develops and relates to other individual, social and institutional factors. In general, the role of the social and institutional context in the process of coherence making should also be further studied. The results of this dissertation showed that there are gaps between the perceptions of stakeholders working at different levels of the educational system. These gaps might lead to different understandings of the curriculum in terms of what should be changed, and to various meanings and activities in practice. Since it has been suggested that the process of coherence making is mediated in interaction within and between the different levels of the educational system, it would be useful to examine how the district and school contexts influence the coherence making of schools and teachers. Thus, multilevel analysis could contribute to filling this gap.

More generally, curriculum coherence should also be examined in relation to pupils' experiences, because the final aim of most school reforms is to increase

pupil achievement and well-being in schools. Examining coherence from the perspective of pupils could provide an important addition to the understanding on the relation between the perceived curriculum by educational stakeholders and the enacted curriculum experienced by pupils.

References

Adelman, H. S. & Taylor, L. (2007). Systemic change for school improvement. *Journal of Educational and Psychological Consultation*, *17*(1), 55–77.

Allen, C. D. & Penuel, W. R. (2015). Studying teachers' sensemaking to investigate teachers' responses to professional development focused on new standards. *Journal of Teacher Education*, *66*(2), 136–149.

Allison, M. & Kaye, J. (2015). *Strategic planning for nonprofit organizations: A practical guide for dynamic times* (3rd ed.). Hoboken, New Jersey: John Wiley & Sons.

Anderson, L. W. (2002). Curricular alignment: A re-examination. *Theory into Practice*, *41*(4), 255–260.

Asparouhov, T. & Muthén, B. (2014a). Auxiliary variables in mixture modeling: Three-step approaches using Mplus. *Structural Equation Modeling: A Multidisciplinary Journal*, *21*(3), 329–341.

Asparouhov, T. & Muthén, B. (2014b). *Auxiliary variables in mixture modeling: Using the BCH method in Mplus to estimate a distal outcome model and an arbitrary secondary model*. Mplus Web Notes, 21, Version 2. Retrieved September 1st, 2019 from: https://www.statmodel.com/examples/webnotes/webnote21.pdf

Atjonen, P. (1993). *Kunnan opetussuunnitelma koulun hallinnollisen ja pedagogisen kehittämisen kohteena ja välineenä [The local curriculum as an object and instrument in the administrative and pedagogical development of the school system]*. Acta Universitatis Ouluensis, E, 11. Oulu: University of Oulu.

Atjonen, P., Halinen, I., Hämäläinen, S., Korkeakoski, E., Knubb-Manninen, G., Kupari, P., Mehtäläinen, J., Risku, A-M., Salonen, M., Wikman, T. (2008). *Tavoitteista vuorovaikutukseen: Perusopetuksen pedagogiikan arviointi [From goals to interaction: Evaluation of pedagogy in Finnish basic education]*. Publications by the Education Evaluation Council 30. Vaajakoski: Gummerus.

Bakkenes, I., Vermunt, J. D., & Wubbels, T. (2010). Teacher learning in the context of educational innovation: Learning activities and learning outcomes of experienced teachers. *Learning and Instruction*, *20*(6), 533–548.

Beane, J. A. (1995). Introduction: What is a coherent curriculum? In J.A. Beane (Ed.), *Toward a coherent curriculum* (pp. 1–14). Alexandria, VA: ASCD.

Ben-Peretz, M. (1990). *The teacher-curriculum encounter: Freeing teachers from the tyranny of texts*. Albany: State University of New York Press.

Bergman, L. R. & El-Khouri, B. M. (2003). A person oriented approach: Methods for today and methods for tomorrow. *New Directions for Child and Adolescent Development*, *2003*(101), 25–38.

Bergman, L. R. & Trost, K. (2006). The person-oriented versus the variable-oriented approach: Are they complementary, opposites, or exploring different worlds? *Merrill-Palmer Quarterly*, *52*(3), 601–632.

Berlin, K. S., Williams, N. A., & Parra, G. R. (2014). An introduction to latent variable mixture modeling (part 1): Overview and cross-sectional latent class and latent profile analyses. *Journal of Pediatric Psychology*, *39*(2), 174–187.

Berman, P. & McLaughlin, M. W. (1976). Implementation of educational innovation. *The Educational Forum*, *40*(3), 345–370.

Biggs, J. B. & Tang, T. S. (2011). *Teaching for quality learning at university* (4th ed.). Maidenhead: Open University Press.

Bliss, C. M. & Wanless, S. B. (2018). Development and initial investigation of a self-report measure of teachers' readiness to implement. *Journal of Educational Change*, *19*(2), 269–291.

Boesen, J., Helenius, O., Bergqvist, E., Bergqvist, T., Lithner, J., Palm, T., & Palmberg, B. (2014). Developing mathematical competence: From the intended to the enacted curriculum. *The Journal of Mathematical Behavior*, *33*, 72–87.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.

Bryson, J. M. (1995). *Strategic planning for public and nonprofit organizations* (revised edition). San Fransisco: Jossey-Bass.

Buchmann, M. & Floden, R.E. (1992). Coherence, the rebel angel. *Educational Researcher*, *21*(9), 4–9.

Butler, D. L., Schnellert, L., & MacNeil, K. (2015). Collaborative inquiry and distributed agency in educational change: A case study of a multi-level community of inquiry. *Journal of Educational Change, 16*(1), 1–26.

Byrne, B. M. (2012). *Structural equation modeling with Mplus*. New York: Routledge.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin*, *105*(3), 456–466.

Canrinus, E. T., Bergem, O. K., Klette, K., & Hammerness, K. (2017). Coherent teacher education programmes: taking a student perspective. *Journal of Curriculum Studies*, *49*(3), 313–333.

Cantlon, D., Rushcamp, S., & Freeman, D. (1990). The interplay between state and district guidelines for curriculum reform in elementary schools. *Journal of Education Policy*, *5*(5), 63–80.

Century, J. & Cassata, A. (2016). Implementation research: finding common ground on what, how, why, where, and who. *Review of Research in Education*, *40*(1), 169–215.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464–504.

Chen, F. F., Sousa, K. H., & West, S. G. (2005). Teacher's corner: Testing measurement invariance of second-order factor models. *Structural Equation Modeling: A Multidisciplinary Journal*, *12*(3), 471–492.

Cheung, A. C. K. & Wong, P. M. (2011). Effects of school heads' and teachers' agreement with the curriculum reform on curriculum development progress and student learning in Hong Kong. *International Journal of Educational Management*, *25*(5), 453–473.

Cheung, G. W. & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *9*(2), 233–255.

Choi, T.-H. & Walker, A. D. (2018). A heuristic model for tailoring teacher development to educational reforms: Focusing on ambiguity and conflict generation. *Teaching and Teacher Education*, *74*, 72–84.

Chrispeels, J. H. & González, M. (2006). The challenge of systemic change in complex educational systems. In A. Harris, & J. H. Chrispeels (Eds.), *Improving schools and educational systems* (pp. 241–273). New York: Routledge.

Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis*, *23*(2), 145–170.

Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, *32*(6), 3–12.

Coburn, C. E. (2004). Beyond decoupling: Rethinking the relationship between the institutional environment and the classroom. *Sociology of Education*, *77*(3), 211–244.

Coburn, C. E. (2005). Shaping teacher sensemaking: School leaders and the enactment of reading policy. *Educational Policy*, *19*(3), 476–509.

Coburn, C. E. & Russell, J. L. (2008). District policy and teachers' social networks. *Educational Evaluation and Policy Analysis*, *30*(3), 203–235.

Cohen, D. K. (1990). A revolution in one classroom: The case of Mrs. Oublier. *Educational Evaluation and Policy Analysis*, *12*(3), 311–329.

Cohen, S. A. (1987). Instructional alignment: Searching for a magic bullet. *Educational Researcher*, *16*(8), 16–20.

Cohen, D. K. & Hill, H. C. (2000). Instructional policy and classroom performance. *Teachers College Record*, *102*(2), 294–343.

Cohen, D. K. & Spillane, J. P. (1993). Policy and practice: The relations between governance and instruction. In S. H. Fuhrman (Ed.), *Designing coherent educational policy* (pp. 35–95). San Fransisco: Jossey Bass.

Confrey, J., Castro-Filho, J., & Wilhelm, J. (2000). Implementation research as a means to link systemic reform and applied psychology in mathematics education. *Educational Psychologist*, *35*(3), 179–191.

Connelly, F. M. & Xu, S. J. (2010). An overview of research in curriculum inquiry. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International Encyclopedia of Education* (3rd ed.)(pp. 324–334). Oxford: Elsevier.

Creemers, B. P. M. & Kyriakides, L. (2008). *The dynamics of educational effectiveness: A contribution to policy, practice and theory in contemporary schools*. London: Routledge.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches* (4th ed.). Thousand Oaks, CA: SAGE.

Darling-Hammond, L. (1998). Policy and change: Getting beyond bureaucracy. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.), *International handbook of educational change* (pp. 642–667). Dordrecht: Kluwer Academic.

Darling-Hammond, L., Hightower, A. M., Husbands, J. L., LaFors, J. R., Young, V. M., & Christopher, C. (2006). Building instructional quality: 'Inside-out' and 'outside-in' perspectives on San Diego's school reform. In A. Harris, & J. H. Chrispeels (Eds.), *Improving schools and educational systems* (pp. 129–185). New York: Routledge.

Datnow, A. & Park, V. (2009). Conceptualizing policy implementation: Large-scale reform in an era of complexity. In G. Sykes, B. Schneider, & D. N. Plank (Eds.,), *Handbook of Education Policy Research* (pp. 348–361). New York: Routledge.

Datnow, A. & Stringfield, S. (2000). Working together for reliable school reform. *Journal of Education for Students Placed at Risk*, *5*(1-2), 183–204.

Desimone, L. (2006). Consider the source response differences among teachers, principals, and districts on survey questions about their education policy environment. *Educational Policy*, *20*(4), 640–676.

Desimone, L. (2013). Teacher and administrator responses to standards-based reform. *Teachers College Record*, *115*(8), 1–53.

Donnell, L. A. & Gettinger, M. (2015). Elementary school teachers' acceptability of school reform: Contribution of belief congruence, self-efficacy, and professional development. *Teaching and Teacher Education*, *51*, 47–57.

Drake, S. M. & Miller, J. P. (2001). Teachers' perceptions of their roles: Life in and beyond the classroom. *Curriculum and Teaching*, *16*(1), 5–23.

Dutro, E., Fisk, M. C., Koch, R., Roop, L. J., & Wixson, K. (2002). When state policies meet local district contexts: Standards-based professional

development as a means to individual agency and collective ownership. *Teachers College Record*, *104*(4), 787–811.

Elmore, R. (1996). Getting to scale with good educational practice. *Harvard Educational Review*, *66*(1), 1–27.

Fernandez, T., Ritchie, G., & Barker, M. (2008). A sociocultural analysis of mandated curriculum change: The implementation of a new senior physics curriculum in New Zealand schools. *Journal of Curriculum Studies*, *40*(2), 187–213.

Ferrini-Mundy, J., Burrill, G., & Schmidt, W. H. (2007). Building teacher capacity for implementing curricular coherence: mathematics teacher professional development tasks. *Journal of Mathematics Teacher Education*, *10*(4-6), 311–324.

Finnish Advisory Board on Research Integrity (2009). *Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review*. Retrieved September 1st, 2019 from: http://www.tenk.fi/sites/tenk.fi/files/ethicalprinciples.pdf

Finnish Advisory Board on Research Integrity (2012). *Responsible conduct of research and procedures for handling allegations of misconduct in Finland*. Guidelines of the Finnish Advisory Board on Research Integrity 2012. Helsinki: Finnish Advisory Board on Research Integrity.

Finnish National Board of Education (2014). *National core curriculum for basic education 2014*. Finnish National Board of Education. Publications 2016:5.

Fitzpatrick, K. A. (1995). An outcome-based systems perspective on establishing curricular coherence. In J.A. Beane (Ed.), *Toward a coherent curriculum* (pp. 120–128). Alexandria, VA: ASCD.

Fortus, D. & Krajcik, J. (2012). Curriculum coherence and learning progressions. In: B. Fraser, K. Tobin, & C. McRobbie (Eds.), *Second International Handbook of Science Education* (pp. 783–798). Dordrecht: Springer.

Fortus, D., Sutherland Adams, L. M., Krajcik, J., & Reiser, B. (2015). Assessing the role of curriculum coherence in student learning about energy. *Journal of Research in Science Teaching*, *52*(10), 1408–1425.

Foshay, A. W. (2000). *The curriculum: Purpose, substance, practice*. New York: Teachers College Press.

Fullan, M. G. (1993). *Change forces: Probing the depths of educational reform*. London: Falmer.

Fullan, M. G. (1996). Turning systemic thinking on its head. *Phi Delta Kappan*, *77*(6), 420–423.

Fullan, M. G. (2000). The return of large-scale reform. *Journal of Educational Change,* 1(1), 5–27.

Fullan, M. G. (2007). *The new meaning of educational change* (4th ed.). New York: Teachers College Press.

Fullan, M. G. (2008). Curriculum implementation and sustainability. In J. Phillion, M. F. He, & F. M. Connelly (Eds.) *The SAGE handbook of curriculum and instruction* (pp. 113–122). Los Angeles: SAGE.

Fullan, M. G. & Pomfret, A. (1977). Research on curriculum and instruction implementation. *Review of Educational Research*, *47*(1), 335–397.

Fullan, M. G. & Quinn, J. (2016). *Coherence: The right drivers in action for schools, districts, and systems*. Thousand Oaks, CA: Corwin.

Ganon-Shilon, S. & Schechter, C. (2018). School principals' sense-making of their leadership role during reform implementation. *International Journal of Leadership in Education*, *22*(3), 279–300.

Gawlik, M. A. (2015). Shared sense-making: How charter school leaders ascribe meaning to accountability. *Journal of Educational Administration*, *53*(3), 393–415.

Geijsel, F., Sleegers, P., van den Berg, R., & Kelchtermans, G. (2001). Conditions fostering the implementation of large-scale innovation programs in schools: Teachers' perspectives. *Educational Administration Quarterly*, *37*(1), 130–166.

Geraedts, C., Boersma, K. T., & Eijkelhof, H. M. C. (2006). Towards coherent science and technology education. *Journal of Curriculum Studies*, *38*(3), 307–325.

Gregoire, M. (2003). Is it a challenge or a threat? A dual-process model of teachers' cognition and appraisal processes during conceptual change. *Educational Psychology Review*, *15*(2), 147–179.

Grossman, P., Hammerness, K. M., McDonald, M., & Ronfeldt, M. (2008). Constructing coherence: Structural predictors of perceptions of coherence in NYC teacher education programs. *Journal of Teacher Education*, *59*(4), 273–287.

Guskey, T. R. (2003). How classroom assessments improve learning. *Educational Leadership*, 60(5), 7–11.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis* (7th ed.). Harlow: Pearson.

Halinen, I. & Holappa, A.-S. (2013). Curricular balance based on dialogue, cooperation and trust – the case of Finland. In W. Kuiper & J. Berkvens (Eds.) *Balancing curriculum regulation and freedom across Europe*. CIDREE Yearbook 2013 (pp. 39–62). Enschede, the Netherlands: SLO.

Hallinger, P., Bickman, L., & Davis, K. (1996). School context, principal leadership and student achievement. *Elementary School Journal*, *96*(5), 498–518.

Hallinger, P. & Heck, R. H. (2002). What do you call people with visions? The role of vision, mission, and goals in school leadership and improvement. In K. Leithwood, & P. Hallinger (Eds.), *Handbook of research in educational leadership and administration* (2nd ed.) (pp. 9–40). Dordrecht: Kluwer Academic.

Hammerness, K. (2006). From coherence in theory to coherence in practice. *Teachers College Record*, *108*(7), 1241–1265.

Heinonen, J.-P. (2005). *Opetussuunnitelmat vai oppimateriaalit [Curricula or educational materials]*. Tutkimuksia 257. Helsinki: University of Helsinki.

Honig, M. I. & Hatch, T. C. (2004). Crafting coherence: How schools strategically manage multiple, external demands. *Educational Researcher*, *33*(8), 16–30.

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Kelly, A. V. (2009). *The curriculum: Theory and practice* (6th ed.). Los Angeles, CA: SAGE.

Ketelaar, E., Beijaard, D., Boshuizen, H. P. A., & Den Brok, P. J. (2012). Teachers' positioning towards an educational innovation in the light of ownership, sense-making and agency. *Teaching and Teacher Education*, *28*(2), 273–282.

Klein, J. T. (Ed.) (2002). *Interdisciplinary education in K-12 and college: A foundation for K-16 dialogue*. New York: College Board.

Knapp, M. S. (1997). Between systemic reforms and the mathematics and science classroom: The dynamics of innovation, implementation, and professional learning. *Review of Educational Research*, *67*(2), 227–266.

Kohonen, V. (2001). Teacher growth and site-based curriculum development: Developing inservice teacher education. In: E. Kimonen (Ed.), *Curriculum approaches* (pp. 35–53). Institute for Educational Research and Department of Teacher Education, University of Jyväskylä. Jyväskylä: University Printing House.

Komiteanmietintö (1970). *Peruskoulun opetussuunnitelmakomitean mietintö I: Opetussuunnitelman perusteet [Memorandum of the comprehensive school committee I: Foundations of the comprehensive school curriculum]*. Komiteanmietintö 1970: A 4. Helsinki: Valtion painatuskeskus

Koskenniemi, M. & Hälinen, K. (1970). *Didaktiikka [Didactics]*. Keuruu: Otava.

Kosunen, T. (1994). *Luokanopettaja kirjoitetun opetussuunnitelman käyttäjänä ja kehittäjänä [Class teacher as the user and developer of the written curriculum]*. Joensuun yliopiston kasvatustieteellisiä julkaisuja, 20. Joensuu: University of Joensuu.

Kumpulainen, K. & Lankinen, T. (2016). Striving for educational equity and excellence: Evaluation and assessment in Finnish basic education. In Niemi, H., Toom, A., & Kallioniemi, A. (Eds.), *Miracle of education: The principles and practices of teaching and learning in Finnish schools* (2nd ed.)(pp. 71–82). Rotterdam: SensePublishers.

Kurz, A., Elliott, S. N., Wehby, J. H., & Smithson, J. L. (2010). Alignment of the intended, planned, and enacted curriculum in general and special education and its relation to student achievement. *The Journal of Special Education*, *44*(3), 131–145.

Kyriakides, L., Creemers, B. P. M., & Antoniou, P. (2009). Teacher behaviour and student outcomes: Suggestions for research on teacher training and professional development. *Teaching and Teacher Education*, *25*(1), 12–23.

Kysilka, M. L. (1998). Understanding integrated curriculum. *The Curriculum Journal, 9*(2), 197–209.

Lasky, S., Datnow, A., & Stringfield, S. (2005). Linkages between federal, state and local levels in educational reform. In N. Bascia, A. Cumming, A. Datnow, K. Leithwood, & D. Livingstone (Eds.), *International handbook of educational policy* (pp. 239–259). Dordrecht: Springer.

Laursen, B. P. & Hoff, E. (2006). Person-centered and variable-centered approaches to longitudinal data. *Merrill-Palmer Quarterly*, *52*(3), 377–389.

Leithwood, K., Harris, A., & Hopkins, D. (2008). Seven strong claims about school leadership. *School Leadership and Management*, *28*(1), 27–42.

Letschert, J. & Kessels, J. (2003). Social and political factors in the process of curriculum change. In J. van den Akker, W. Kuiper, & U. Hameyer (Eds.), *Curriculum landscapes and trends* (pp. 157–176). Dordrecht: Kluwer Academic Publishers.

Levin, B. (2001). Education reform from an international perspective. *Education Policy Analysis Archives*, 9(14). Retrieved September 1st, 2019 from: https://epaa.asu.edu/ojs/article/view/343.

Li, Q. & Ni, Y. (2011). Impact of curriculum reform: Evidence of change in classroom practice in mainland China. *International Journal of Educational Research*, *50*(2), 71–86.

Lindvall, J. & Ryve, A. (2019). Coherence and the positioning of teachers in professional development programs. A systematic review. *Educational Research Review*, *27*, 140–154.

Lo, M. (2000). Learning without tears? The relativity of a curriculum reform and its implementation. In K. Chan, T. Kwan, & B. Adamson (Eds.), *Changing the curriculum: The impact of reform on primary schooling in Hong Kong* (pp. 47–79). Hong Kong: Hong Kong University Press.

Louis, K. S., Febey, K., & Schroeder, R. (2005). State-mandated accountability in high schools: Teachers' interpretations of a new era. *Educational Evaluation and Policy Analysis*, *27*(2), 177–204.

Louis, K. S. & Miles, M. B. (1991). Managing reform: Lessons from urban high schools. *School Effectiveness and School Improvement*, *2*(2), 75–96.

Louis, K. S. & Robinson, V. M. (2012). External mandates and instructional leadership: school leaders as mediating agents. *Journal of Educational Administration*, *50*(5), 629–665.

Lubke, G. H. & Muthén, B. O. (2005). Investigating population heterogeneity with factor mixture models. *Psychological Methods*, *10*, 21–39.

Luttenberg, J., Carpay, T., & Veugelers, W. (2013). Educational reform as a dynamic system of problems and solutions: Towards an analytic instrument. *Journal of Educational Change*, *14*, 335–352.

Luttenberg, J., van Veen, K., & Imants, J. (2013). Looking for cohesion: the role of search for meaning in the interaction between teacher and reform. *Research Papers in Education*, *28*(3), 289–308.

Magnusson, D. & Stattin, H. (1998). Person-context interaction theories. In D. Damon & R. M. Lerner (Eds.), *Theoretical models of human development* (pp. 685–759). New York: Wiley.

Malinen, P. (1992). *Opetussuunnitelmat koulutyössä [Curricula in school work]*. Helsinki: VAPK-kustannus.

Manouchehri, A. & Goodman, T. (1998). Mathematics curriculum reform and teachers: Understanding the connections. *The Journal of Educational Research*, *92*(1), 27–41.

Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal*, *11*(3), 320–341.

Martone, A. & Sireci, S. G. (2009). Evaluating alignment between curriculum, assessment, and instruction. *Review of Educational Research*, *79*(4), 1332–1361.

Maulana, R., Helms-Lorenz, M., & van de Grift, W. (2017). Validating a model of effective teaching behaviour of pre-service teachers. *Teachers and Teaching*, *23*(4), 471–493.

McCormick, J., Ayres, P. L., & Beechey, B. (2006). Teaching self-efficacy, stress and coping in a major curriculum reform: Applying theory to context. *Journal of Educational Administration*, *44*(1), 53–70.

McLaughlin, M. (1998). Listening and learning from the field: Tales of policy implementation and situated practice. In: Hargreaves, A., Lieberman, A., Fullan, M. and Hopkins, D. (Eds.), *International handbook of educational change* (pp. 70–84). Dordrecht: Kluwer Academic.

McMahon, T. & Thakore, H. (2006). Achieving constructive alignment: Putting outcomes first. *Quality of Higher Education*, *3*, 10–19.

Morris, P. (2000). The commissioning and decommissioning of curriculum reforms - the career of the target oriented curriculum. In K. Chan, T. Kwan, & B. Adamson (Eds.), *Changing the curriculum: The impact of*

reform on primary schooling in Hong Kong (pp. 21–40). Hong Kong: Hong Kong University Press.

Morris, P., Lo, M., & Adamson, B. (2000). Improving schools in Hong Kong – Lessons from the past. In K. Chan, T. Kwan, & B. Adamson (Eds.), *Changing the curriculum: The impact of reform on primary schooling in Hong Kong* (pp. 245–262). Hong Kong: Hong Kong University Press.

Muthén, L. & Muthén, B. O. (1998-2015). *Mplus users guide* (6th ed.). Los Angeles: Muthen & Muthen.

März, V. & Kelchtermans, G. (2013). Sense-making and structure in teachers' reception of educational reform. A case study on statistics in the mathematics curriculum. *Teaching and Teacher Education*, *29*, 13–24.

Mølstad, C. E. (2015). State-based curriculum-making: Approaches to local curriculum work in Norway and Finland. *Journal of Curriculum Studies*, *47*(4), 441–461.

Nederhof, A. J. (1985). Methods of coping with social desirability bias: A review. *European Journal of Social Psychology*, *15*(3), 263–280.

Nevalainen, R., Kimonen, E., & Hämäläinen, S. (2001). Curriculum changes in the Finnish comprehensive school: The lessons of three decades. In: E. Kimonen (Ed.), *Curriculum approaches* (pp. 123–141). Institute for Educational Research and Department of Teacher Education, University of Jyväskylä. Jyväskylä: University Printing House.

Newmann, F. M., Smith, B., Allensworth, E., & Bryk, A. S. (2001). Instructional program coherence: What it is and why should it guide school improvement policy. *Educational Evaluation and Policy Analysis*, *23*(4), 297–321.

Ng, S. W. (2009). Why did principals and teachers respond differently to curriculum reform? *Teacher Development*, *13*(3), 187–203.

Niemelä, M. A. (2019). Eheyttäminen koulutyössä – Katsaus käsitteeseen [Integration in school work – An overview of the concept]. In M. Rautiainen, & M. Tarnanen (Eds.), *Tutkimuksesta luokkahuoneisiin* (pp. 465–481). Jyväskylä: Jyväskylän yliopisto.

Niemelä, M. A. & Tirri, K. (2018). Teachers' knowledge of curriculum integration: A current challenge for Finnish subject teachers. Teoksessa: Y. Weinberger & Z. Libman (Eds.), *Contemporary Pedagogies in Teacher Education and Development* (pp. 119–132). London: InTech.

Niemi, H. (2015). Teacher effectiveness in the European context with a special reference to Finland. In O. Tan, & W. Liu (Eds.), *Teacher effectiveness: Capacity building in a complex learning era* (pp. 51–78). Singapore: Cengage Learning.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte

Carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(4), 535-569.

OECD (2005). *The definition and selection of key competencies*. Executive summary. Paris: OECD. Retrieved September 1st, 2019 from: https://www.oecd.org/pisa/35070367.pdf

O'Sullivan, K., Carroll, K., & Cavanagh, M. (2008). Changing teachers: Syllabuses, subjects and selves. *Issues in Educational Research*, *18*(2), 167–182.

Paronen, P. & Lappi, O. (2018). *Finnish teachers and principals in figures*. Finnish National Agency for Education. Reports and surveys 2018:4. Helsinki: Juvenes Print.

Penuel, W. R., Fishman, B. J., Gallagher, L. P., Korbak, C., & Lopez-Prado, B. (2009). Is alignment enough? Investigating the effects of state policies and professional development on science curriculum implementation. *Science Education*, *93*, 656–677.

Penuel, W. R., Fishman, B. J., Yamaguchi, R., & Gallagher, L. P. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal*, *44*(4), 921–958.

Pietarinen, J., Pyhältö, K., & Soini, T. (2017). Large-scale curriculum reform in Finland – exploring the interrelation between implementation strategy, the function of the reform, and curriculum coherence. *The Curriculum Journal*, *28*(1), 22–40.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903.

Porter, A. C. (2002). Measuring the content of instruction: Uses in research and practice. *Educational Researcher*, *31*(7), 3–14.

Priestley, M. (2011). Schools, teachers, and curriculum change: A balancing act? *Journal of Educational Change, 12*(1), 1–23.

Priestley, M., Minty, S., & Eager, M. (2014). School-based curriculum development in Scotland: curriculum policy and enactment. *Pedagogy, Culture & Society, 22*(2), 189–211.

Purkey, S. & Smith, M. (1983). Effective schools - a review. *The Elementary School Journal, 83,* 426–452.

Putnick, D. L. & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, *41*, 71–90.

Pyhältö, K., Pietarinen, J., & Soini, T. (2012). Do comprehensive school teachers perceive themselves as active professional agents in school reforms? *Journal of Educational Change, 13*(1), 95–116.

Pyhältö, K., Pietarinen, J., & Soini, T. (2014). Comprehensive school teachers' professional agency in large-scale educational change. *Journal of Educational Change*, *15*(3), 303–325.

Pyhältö, K., Pietarinen, J., & Soini, T. (2018). Dynamic and shared sense-making in large-scale curriculum reform in school districts. *The Curriculum Journal*, *29*(2), 181–200.

Ramberg, M. R. (2014). What makes reform work?–School-based conditions as predictors of teachers' changing practice after a national curriculum reform. *International Education Studies*, *7*(6), 46–65.

Reezigt, G. J. & Creemers, B. P. M. (2005). A comprehensive framework for effective school improvement. *School Effectiveness and School Improvement*, *16*(4), 407–424.

Reigeluth, C. M. (1994). The imperative for systemic change. In C. M. Reigeluth, & R. J. Garfinkle (Eds.), *Systemic change in education* (pp. 3–11). New Jersey: Educational Technology Publications.

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, *75*(2), 211–246.

Roach, A. T., Niebling, B. C., & Kurz, A. (2008) Evaluating the alignment among curriculum, instruction, and assessment: Implications and applications for research and practice. *Psychology in the Schools*, *45*(2), 158–176.

Russell, J. L. & Bray, L. E. (2013). Crafting coherence from complex policy messages: educators' perceptions of special education and standards-based accountability policies. *Education Policy Analysis Archives*, 21(12). Retrieved September 1st, 2019 from: http://epaa.asu.edu/ojs/article/view/1044

Sahlberg, P. (1996). Kuka auttaisi opettajaa: post-moderni näkökulma opetuksen muutokseen yhden kehittämisprojektin valossa *[Who would help a teacher: A post-modern perspective on change in teaching in light of a school improvement project]*. Jyväskylä: University of Jyväskylä.

Sahlberg, P. (2015). *Finnish lessons 2.0: What can the world learn from educational change in Finland?* (2nd ed.). New York, NY: Teachers College Press.

Salminen, J. (2018). *Opetussuunnitelman ohjaustapa ja opettajan opetussuunnitelmaosaaminen: opettajan toimijuuden osa-alueiden tarkastelua [The guidance of curriculum and teachers' curriculum competence: examining areas of teacher agency]*. Turun yliopiston julkaisuja, C, 455. Turku: University of Turku.

Salminen, J. & Annevirta, T. (2016). Curriculum and teachers' pedagogical thinking when planning for teaching. *European Journal of Curriculum Studies*, *3*(1), 387–406.

Salonen-Hakomäki, S., Soini, T., Pietarinen, J., & Pyhältö, K. (2016). The way ahead for Finnish comprehensive school? Examining state-level school

administrators' theory of change. *Journal of Curriculum Studies*, *48*(5), 671–691.

Schafer, J. L. & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, *7*(2), 147–177.

Schmidt, W. H. & Houang, R. T. (2012). Curricular coherence and the common core state standards for mathematics. *Educational Researcher*, *41*(8), 294–308.

Schmidt, W. H., Wang, H. C., & McKnight, C. C. (2005). Curriculum coherence: An examination of US mathematics and science content standards from an international perspective. *Journal of Curriculum Studies*, *37*(5), 525–559.

Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday Currency.

Shaked, H. & Schechter, C. (2018) School middle leaders' sense making of a generally outlined education reform. *Leadership and Policy in Schools*, *18*(3), 12–32.

Short, E. C. (2008). Curriculum policy research. In J. Phillion, M. F. He, & F. M. Connelly (Eds.) *The SAGE handbook of curriculum and instruction* (pp. 420–430). Los Angeles: SAGE.

Shwartz, Y., Weizman, A., Fortus, D., Krajcik, J., & Reiser, B. (2008). The IQWST experience: Using coherence as a design principle for a middle school science curriculum. *The Elementary School Journal*, *109*(2), 199–219.

Sleegers, P. J. C., Thoonen, E. E. J., Oort, F. J., & Peetsma, T. T. D. (2014). Changing classroom practices: The role of school-wide capacity for sustainable improvement. *Journal of Educational Administration*, *52*(5), 617–652.

Smith, L. K. & Southerland, S. A. (2007). Reforming practice or modifying reforms?: Elementary teachers' response to the tools of reform. *Journal of Research in Science Teaching*, *44*(3), 396–423.

Smith, M. S. & O'Day, J. A. (1991). Systemic school reform. In S. H. Fuhrman & B. Malen (Eds.), *The politics of curriculum and testing* (pp. 233–268). Bristol, PA: Falmer.

Smith, M. S. & Smith, M. L. (2009). Research in the policy process. In G. Sykes, B. Schneider, & D. N. Plank (Eds.), *Handbook of Education Policy Research* (pp. 372–397). New York: Routledge.

Snijders, T. A. & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Snyder, J., Bolin, F., & Zumwalt, K. (1992). Curriculum implementation. In W. P. Jackson (Ed.), *Handbook of research on curriculum* (pp. 402–435). New York: Macmillan.

Soini, T., Pietarinen, J., & Pyhältö, K. (2018). Shared sense-making strategies in curriculum reform: District-level perspective. *Improving Schools*, *21*(2), 111–126.

Southerland, S., Sowell, S., Blanchard, M., & Granger, E. (2011). Exploring the construct of pedagogical discontentment: A tool to understand science teachers' openness to reform. *Research in Science Education*, *41*(3), 299–317.

Spillane, J. P. (1996). School districts matter: Local educational authorities and state instructional policy. *Educational Policy*, *10*(1), 63–87.

Spillane, J. P. (1998). State policy and the non-monolithic nature of the local school district: organizational and professional considerations. *American Educational Research Journal*, *35*(1), 33–63.

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies*, *31*(2), 143–175.

Spillane, J. P. & Callahan, K. A. (2000). Implementing state standards for science education: What district policy makers make of the hoopla. *Journal of Research in Science Teaching*, *37*(5), 401–425.

Spillane, J. P., Gomez, L. M., & Mesler, L. (2009). Notes on reframing the role of organizations in policy implementation. In G. Sykes, B. Schneider, & D. N. Plank (Eds.), *Handbook of Education Policy Research* (pp. 409–425). New York: Routledge.

Spillane, J. P., Halverson, R., & Diamond, J. B. (2004). Towards a theory of leadership practice: A distributed perspective. *Journal of Curriculum Studies*, *36*(1), 3–34.

Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research*, *72*(3), 387–431.

Squires, D. A. (2009). *Curriculum alignment: Research-based strategies for increasing student achievement*. Thousand Oaks: Corwin Press.

Squires, D. A. (2012). Curriculum alignment research suggests that alignment can improve student achievement. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *85*(4), 129–135.

Steenkamp, J.-B. E. M. & Baumgartner, H. (1998). Assessing measurement invariance in cross-national consumer research. *Journal of Consumer Research*, *25*(1), 78–90.

Steinmetz, H. (2013). Analyzing observed composite differences across groups: Is partial measurement invariance enough? *Methodology: European Journal of Research Methods for the Behavioral and Social Sciences*, *9*(1), 1–12.

Stosich, E. L. (2018). Principals and teachers "craft coherence" among accountability policies. *Journal of Educational Administration*, *56*(2), 203–219.

Sulonen, K., Heilä-Ylikallio, R., Junttila, N., Kola-Torvinen, P., Laine, T., Ropo, E., Suortamo, M., Knugg-Manninen, G., Korkeakoski, E. (2010). *Esi- ja perusopetuksen opetussuunnitelmajärjestelmän toimivuus [The functionality of the Finnish pre-primary and basic education curriculum system]*. Publications by the Finnish Educational Evaluation Council 52. Jyväskylä: Bookwell.

Sykes, G., O'Day, J., & Ford, T. G. (2009). The district role in instructional improvement. In G. Sykes, B. Schneider, & D. N. Plank (Eds.), *Handbook of Education Policy Research* (pp. 767–784). New York: Routledge.

Tan, Y. S. M. & Nashon, S. M. (2015). Promoting teachers' collaborative exploration of a new science curriculum: the case of a Singapore learning study. *Professional Development in Education*, *41*(4), 671–689.

Thoonen, E. E. J., Sleegers, P. J. C., Oort, F. J., & Peetsma, T. T. D. (2012). Building school-wide capacity for improvement: The role of leadership, school organizational conditions, and teacher factors. *School Effectiveness and School Improvement*, *23*(4), 441–460.

Tian, M. & Risku, M. (2019). A distributed leadership perspective on the Finnish curriculum reform 2014. *Journal of Curriculum Studies*, *51*(2), 229–244.

Tikkanen, L., Pyhältö, T., Soini, T., & Pietarinen, J. (2017). Primary determinants of a large-scale curriculum reform – National board administrators' perspectives. *Journal of Educational Administration*, *55*(6), 702–716.

Timperley, H. & Parr, J. (2005). Theory competition and the process of change. *Journal of Educational Change, 6*(3), 227–251.

Tyack, D. & Cuban, L. (1995). *Tinkering toward utopia: A century of public school reform*. Cambridge: Harvard University Press.

Tyler, R. W. (1949). *Basic principles of curriculum and instruction*. Chicago: The University of Chicago Press.

Ullman, J. B. (2007). Structural equation modeling. In B. G. Tabachnick, & L. S. Fidell (Eds.), *Using multivariate statistics* (5th ed.)(pp. 676–780). Boston: Pearson.

van de Grift, W. (2007). Quality of teaching in four European countries: a review of the literature and application of an assessment instrument. *Educational Research*, *49*(2), 127–152.

van den Akker, J. (2003). Curriculum perspectives: An introduction. In: J. van den Akker, W. Kuiper, & U. Hameyer (Eds.), *Curriculum landscapes and trends* (pp. 1–10). Dordrecht: Kluwer Academic Publishers.

Vermunt, J. K. & Magidson, J. (2002). Latent class cluster analysis. In J. A. Hagenaars, & A. L. McCutcheon (Eds.), *Applied latent class analysis* (pp. 89–106). Cambridge, UK: Cambridge University Press.

Vitikka, E. (2009). *Opetussuunnitelman mallin jäsennys: Sisältö ja pedagogiikka kokonaisuuden rakentajina [Structuring curriculum design: Content and pedagogy constructing the whole].* Kasvatusalan tutkimuksia, 44. Jyväskylä: Jyväskylän yliopistopaino.

Vitikka, E., Krokfors, L., & Rikabi, L. (2016). The Finnish national core curriculum. In H. Niemi, A. Toom & A. Kallioniemi (Eds.), *Miracle of education* (2nd revised ed.)(pp. 83–96). Rotterdam: SensePublishers.

Voogt, J.M., Pieters, J. M., & Handelzalts, A. (2016). Teacher collaboration in curriculum design teams: effects, mechanisms, and conditions. *Educational Research and Evaluation*, *22*(3-4), 121–140.

Voogt, J. & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, *44*(3), 299–321.

Wang, J. & Wang, X. (2012). *Structural equation modeling: Applications using Mplus*. Chichester, West Sussex: Wiley.

Waugh, R. & Godfrey, J. (1993). Teacher receptivity to system-wide change in the implementation stage. *British Educational Research Journal*, *19*(5), 565–578.

Webb, N. L. (1997). *Determining alignment of expectations and assessments in mathematics and science education*. NISE Brief, 1(2). Madison: National Institute for Science Education.

Webb, N. L. (1999). *Alignment of science and mathematics standards and assessment in four states* (NISE Research Monograph No.18). Madison: National Institute for Science Education.

Weick, K. E. (1995). *Sensemaking in organisations*. Thousand Oaks: SAGE.

Wong, P.-M. & Cheung, A. C. (2009). Managing the process of an educational change: A study of school heads' support for Hong Kong's curriculum reform. *International Journal of Educational Management*, *23*(1), 87–106.

Yildirim, A. & Kasapoglu, K. (2015). Teachers' perceptions of constructivist curriculum change as a predictor of their perceptions of the implementation of constructivist teaching–learning activities. *Asia Pacific Education Review*, *16*(4), 565–577.

Yin, H., Lee, J. C., & Jin, Y. (2011). Teacher receptivity to curriculum reform and the need for trust: an exploratory study from Southwest China. *The Asia-Pacific Education Researcher*, *20*(1), 35–47.

Yuen, T. W. W., Cheung, A. C. K., & Wong, P. M. (2012). A study of the impact of the first phase of the curriculum reform on student learning in Hong Kong. *International Journal of Educational Management*, *26*(7), 710–728.

Appendices

Appendix A: Sample means, standard deviations, minimum and maximum values for curriculum coherence and school impact for each cohort.

Curriculum coherence	M	SD	Min	Max
Consistency of the intended direction				
1. State-level stakeholders	5.04	0.99	1.33	6.83
2. District-level stakeholders	4.34	1.00	1.17	6.83
3. Teachers T1	3.90	1.00	1.00	7.00
4. Teachers T2	3.76	1.03	1.00	6.50
Integrative approach to teaching and learning				
1. State-level stakeholders	5.45[a]	0.88	1.75	7.00
2. District-level stakeholders	5.23[a]	0.86	1.75	7.00
3. Teachers T1	5.02	0.85	1.75	7.00
4. Teachers T2	4.79	0.90	1.00	6.75
Alignment between objectives, content and assessment				
1. State-level stakeholders	5.32	0.73	3.29	6.71
2. District-level stakeholders	4.87	0.80	2.00	7.00
3. Teachers T1	4.46	0.81	1.33	6.67
4. Teachers T2	4.35	0.84	1.00	6.43
School impact	**M**	**SD**	**Min**	**Max**
1. State-level stakeholders	5.04	1.04	1.00	7.00
2. District-level stakeholders	4.76	0.96	1.33	7.00
3. Teachers T1	4.46	0.96	1.00	7.00
4. Teachers T2	4.28	0.99	1.00	7.00

[a]The difference between means with the same letter is not statistically significant.

Note. Differences between teachers' scores at T1 and T2 were tested using paired samples t-tests, all other mean differences were tested with ANOVA using Bonferroni post hoc comparisons.