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Heli Kallio

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University of Turku

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ABSTRACT

The purpose of this doctoral thesis was to deepen existing understanding of teachers' metacognitive awareness (MA), defined here as the individual's ability to be aware of, understand and specify one's thinking about learning. This model of MA draws a theoretical distinction between two main components: knowledge of cognition and regulation of cognition. The dissertation's aims were theoretical, methodological and empirical in nature.

The theoretical aim was to examine teacher support for learner MA. Study I assessed the utility of the widely used current theory of MA for examining MA among Finnish teachers (N = 208). As teacher MA impacts the support provided to learners, Study II assessed the suitability of this theoretical model for examining learners' (N = 578) MA. A theoretical account of how learner self-evaluation links to overall MA was examined. In Study III (N = 1045), a new theoretical model of support for MA was constructed on the basis of the findings of Study I and Study II. The methodological aim was to develop a measure of perceived teacher support for learner MA. Study I assessed the utility of a measure operationalized in terms of the current theoretical model, using an instrument adapted for international use, and translated and validated in Finnish. Study II assessed the suitability of the new theoretical account for examining learner MA. In Study III, a new instrument for measuring perceived teacher support for learner MA was developed and tested, based on Study I and Study II. The empirical aim was to explore how teachers support learner MA. Study I and Study II confirmed the validity and reliability of the self-report measures in a Finnish education context, and the underlying theoretical model's ability to account for these data. As a further empirical issue, Study III explored teachers' perceived support for learner MA across different teaching domains.

The results of Confirmatory Factor Analysis of the data from Study I and Study II revealed good/acceptable fit of the factor structure of both measures of MA, whose utility was separately confirmed for both teachers and learners. Study II confirmed the hypothesis that self-evaluation serves as a reference component linking knowledge of cognition and regulation of cognition. Self-evaluation was therefore examined in Study III as a key element of MA. The results of Structural Equation Modelling in Study II confirmed that learners' knowledge of conditions (conditional knowledge) predicted learners' knowledge of learning content selection (declarative

knowledge), as well as knowledge of self-evaluation of learning. Activity in planning one's own learning predicted monitoring and debugging activity during learning, as well as activity in self-evaluation of learning strategies at the end of the learning process. Study III explored perceived teacher support for learner MA across different teaching domains in terms of three main components: knowledge of learning objects, regulation of learning strategies and self-evaluation.

The findings clarify how teachers currently address the challenges of teaching 21st century skills such as lifelong learning and metacognition. As learners' responsibility for their own learning is increasingly highlighted at all levels of education, teacher support for learner MA becomes crucial. The findings indicate that while special teachers provide most support for learner MA, subject teacher support for MA varies across components within subject groups. There was also a statistically significant difference between genders, in that women supported learner MA more systematically than men for all components and across all teacher groups.

In sum, the findings confirm the validity of the proposed measures and can be used to inform ways of teaching and learning in teacher education. The results also confirm the perceived need to develop teachers' ability to support learner MA, both during pre-service education and in-service further education.

KEYWORDS**:** teachers' support, metacognitive awareness, knowledge of cognition, regulation of cognition, self-evaluation

TURUN YLIOPISTO
Kasvatustieteiden tiedekunta
Opettajankoulutuslaitos
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Väitöskirja, 165 s.
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TIIVISTELMÄ

Tämän väitöskirjan tutkimustehtävänä oli syventää nykytietoon perustuvaa ymmärrystä opettajien metakognitiivisesta tietoisuudesta ja tutkia opettajien käsitystä antamastaan tuesta oppijoiden metakognitiiviselle tietoisuudelle. Metakognitiivinen tietoisuus (MT) määritellään yleisesti tietoisuudeksi, johon kuuluvat tieto ajattelusta ja toiminnan säätelystä. Tässä tutkimuksessa tarkastellaan sitä oppimisen näkökulmasta. Tutkimuksen teoreettisena lähtökohtana oli MT:n jaottelu oppimisen tiedon ja säätelyn pääkomponentteihin. Väitöskirjassa tarkasteltiin MT:ta teoreettisesti, metodologisesti ja empiirisesti.

Tutkimuskokonaisuuden teoreettisena tavoitteena oli tarkastella oppijoiden MT:n tukemista. Osatutkimuksessa I tarkasteltiin aiemman tutkimuksen teorian soveltuvuutta suomalaisten opettajien (N=208) MT:n tutkimiseen. Osatutkimuksessa II jäsennettiin MT:n teoreettista mallia. Oppijan itsearviointia tarkasteltiin yhteydessä muihin MT:n osa-alueisiin. Koska opettajan tuki kohdistuu oppijoihin, osatutkimuksessa II tarkasteltiin mallin soveltuvuutta opiskelijoiden (N=578) MT:n tutkimiseen. Osatutkimusten I ja II perusteella rakennettiin MT:n tukemisen mallia, jota käytettiin osatutkimuksessa III (N=1045) jäsentämään MT:n tukemisen teoriaa. Metodologisena tavoitteena oli rakentaa mittari, jolla voidaan tuottaa tietoa opettajan käsityksestä antamastaan tuesta oppijoiden MT:lle. Osatutkimuksessa I tarkasteltiin, kuinka MT:n teoreettisesta mallista operationalisoitu mittaus soveltuu suomalaisten opettajien tutkimiseen. Tutkimuksessa validoitiin suomeksi kansainvälisesti käytettäväksi sovellettu mittari. Osatutkimuksessa II tarkasteltiin tässä tutkimuksessa kehitetyn uuden teoreettisen jäsennyksen soveltuvuutta oppijoiden MT:n tutkimiseen. Osatutkimuksessa III kehitettiin ja testattiin I ja II osatutkimuksen tulosten avulla uusi mittari, jolla voidaan tuottaa tietoa opettajan käsityksestä antamastaan tuesta oppijoiden MT:lle. Empiirisenä tavoitteena oli tuottaa tietoa siitä, miten opettajat kokevat tukevansa oppijoiden MT:ta. Osatutkimuksessa I ja II saatiin tietää, kuinka hyvin kansainvälisesti validoiduissa kyselytutkimuksissa käytettyjä lomakkeita voidaan soveltaa Suomessa. Osatutkimuksessa III tarkasteltiin sitä, miten eritaustaiset opettajat eri oppiaineissa ja koulutusmuodoissa kokevat tukevansa oppijoiden MT:ta.

Tulokset konfirmatorisista faktorianalyyseistä osatutkimuksissa I ja II osoittivat näissä tutkimuksessa suomennettujen MT:n tutkimiseen tarkoitettujen mittarien rakenteen validiteetin. Niiden käytettävyys voitiin vahvistaa erikseen sekä opettajille

että oppijoille. Osatutkimuksen II hypoteesi, jonka mukaan itsearviointi toimii referenssikomponenttina MT:n tiedon ja säätelyn pääkomponenttien välillä, sai vahvistusta. Tästä syystä itsearvioinnista muodostettiin osatutkimuksessa III oma pääkomponenttinsa. Polkumallinnus osatutkimuksessa II osoitti, että oppijoiden tietoisuus oman oppimisensa ehdoista ennusti hänen tietoisuuttaan oppimisensa sisällöistä ja edelleen sitä, että hän arvioi itse omia oppimistuloksiaan. Oppijoiden aktiivisuus oman oppimisensa suunnittelussa ennustaa hänen aktiivisuuttaan myös oppimisen aikaisessa oman oppimisensa tarkkailussa ja suuntaamisessa. Nämä ennustavat edelleen aktiivisuutta oppimisen lopuksi tapahtuvassa oman oppimisprosessin arvioinnissa. Osatutkimuksessa III tutkittiin opettajien tukea oppilaan MT:lle kolmella ulottuvuudella, jotka olivat tieto omasta oppimisesta, omien oppimisstrategioiden säätely ja itsearviointi.

Tulosten perusteella voidaan päätellä, miten opettajat tällä hetkellä kokevat vastaavansa haasteeseen opettaa tulevaisuuden taitoja, kuten elinikäinen oppiminen ja metakognitiiviset taidot. Nykyaikaisessa oppijakeskeisessä kulttuurissa oppijoiden vastuuta omasta oppimisestaan korostetaan kaikilla koulutustasoilla ja -aloilla. Tämä tekee tulevaisuudessa opettajien tuen oppilaiden MT:lle entistä tärkeämmäksi. Tämän tutkimuksen tulosten mukaan erityisopettajat tukivat oppilaiden MT:ta eniten. Aineenopettajien antama tuki oppijoiden MT:n eri osa-alueilla vaihteli oppiaineittain. Naisopettajat tukivat miesopettajia enemmän tilastollisesti merkitsevällä tavalla oppijoiden MT:ta kaikilla osa-alueilla.

Yhteenvetona voidaan todeta, että kaikissa osatutkimuksissa käytetyt mittausmenetelmät soveltuvat MT:n arviointiin. Tuloksia voidaan hyödyntää opettajankoulutuksen opetus- ja oppimistapojen kehittämiseen. Tutkimustulokset vahvistavat käsitystä, että opettajankoulutusta tulisi kehittää siten, että koulutusta MT:n tukemisesta tulisi lisätä sekä opettajaksi opiskelun aikana, että jo työssä oleville opettajille jatkokoulutuksena.

AVAINSANAT: metakognitiivinen tietoisuus, opettajan tuki, metakognitiivinen tieto, metakognitiivinen oppimisensäätely, itsearviointi

Acknowledgements

During my years as a teacher and an educator, I have always been curious as to what goes on in the human mind while teaching and learning. As this idea continued to trouble me, I felt I had no other choice but to try to arrange my thoughts around it and piece together what could be found out about it. Finally, with a study plan of high enough quality to be presented, I needed to find a professor who would be as excited by it as I was. I could not have made a better choice than to call Professor Emerita Arja Virta. That phone call marked the beginning of our mutual long-term journey. Having her as my supervisor made this dissertation possible in terms of everything. I would like to express my warmest appreciation for believing in my plans and research ideas from the very first moment of this dissertation process. I am deeply thankful to her for supporting me and pushing me forwards over so many hills. Her deep expertise in education, learning, teaching, and learning environments has inspired me throughout this journey until this very moment. Arja, without your broad understanding and foresight I would have gotten stuck on the unessential details too often. You really helped me to see the forest from the trees!

Quite soon after receiving a doctoral candidate position on the Doctoral Programme on Learning, Teaching and Learning Environments Research (OPPI), I realized that I am dealing with very important, but extremely multifaceted phenomena. Whilst proceeding, the thesis took on a new direction. Being focused on teachers' concepts of learning and teaching kept leading my thoughts towards the field of metacognition. Thanks to the novel approach, I gained two experts as my new academic supervisors, whose experience and deep understanding gave renewed enthusiasm and faith to take this thesis forward. To my second supervisor, Adjunct Professor Dr. Kalle Virta from the Faculty of Educational Sciences at University of Helsinki, I am in gratitude for our long and deep discussions. Your ability to see the core of the matter has surprised me many times. Thank you also for bringing strength and humor to all those long and anesthetizing moments when the data appeared to be huge and tricky.

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your devotion to supervise me! I admire your expertise in research on education, especially on metacognition. Your dissertation has inspired me a lot and guided me in writing a thesis of my own. Furthermore, I feel privileged to have had the opportunity to co-author with you in our study. Thank you Tuike!

Without discussion, feedback, and constructive criticism, research does not go forward. I am thankful for having had Professor Regina Mulder from the Faculty of Human Sciences at the University of Regensburg, Germany, and Professor Raija Hämäläinen from the Faculty of Education and Psychology at the University of Jyväskylä, Finland, as pre-reviewers of my thesis. Having such expert researchers as my pre-reviewers was a great honor and pleasure. Their supportive feedback not only inspired me to improve the thesis, but also encouraged me to continue with my research topics in the future. Moreover, I am particularly thankful to Professor Raija Hämäläinen, for agreeing to be the opponent at the public defense of my dissertation. I feel humbled and honored to have this opportunity for our discussion, which will surely guide me in taking the next steps in my research.

During the long journey of writing this dissertation, I have been grateful to have co-operated and learned from a number of academic people working beside me. Collaboration between researchers from different universities has made an important contribution to my thinking. I would like to express my warm gratitude to Professor Risto Hotulainen from University of Helsinki's Centre for Educational Assessment (CEA), for giving me the opportunity to co-operate with you as a researcher in assessing learning and teaching when new pedagogical approaches are implemented. I highly respect your expertise in the field of learning to learn. I also want to thank my dear partners in co-operation from the University of Southeast Norway, Universitetet i Sørøst-Norge, Mr. Jostein Sandven, Head of the Department, and Mr. Professor Finn Hjardemaal. Thank you for inviting me as a visiting researcher to Notodden, Department of Education and School Development, in January 2017. Our mutual research has inspired me a lot. Det har vært en stor glede å samarbeide med dere, og jeg håper at vi kan fortsette våre felles prosjekter i fremtiden. Varm takk!

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Language matters a great deal in science. My special thanks for proof-reading this thesis belongs to Kaarlo Kallio. I also want to thank Jussi Wikberg for assistance with the language in Study I. The credit for the Spanish abstract in Study II goes to Veera Ahlbom and Camilo Valiño Fraga. Muchas gracias! And even though the role of the Finnish language is minor in this thesis, those words play an important role in it. Thank you, Meija Wikberg, for helping me with them.

Finally, and most importantly, I will be forever grateful to my dearest ones, Manne, and my precious daughters Eliisa and Linne. Manne, there are no words to express my admiration for you. Besides being a loving husband, you have had the strength to be my supportive mentor and co-author in the sub-studies through all these years. Linne and Eliisa, my greatest sources of inspiration, thank you for your love and patience.

Ja lopuksi, suurin kiitos äidilleni läpi elämän antamastasi tuesta.

in Rauma, June 2020
Heli Kallio

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List of Original Publications

This doctoral thesis is based on the following three studies reported in three original articles. The studies are referred to in the text by their Roman numerals:

Study I Kallio, H., Virta, K., Kallio, M., Virta, A., Hjardemaal, F.R. & Sandven, J. (2017). The Utility of the Metacognitive Awareness Inventory for Teachers among In-service Teachers. *Journal of Education and Learning; 6*(4), 78–91. <https://doi.org/10.5539/jel.v6n4p78>

Study II Kallio, H., Virta, K. & Kallio, M. (2018). Modelling the Components of Metacognitive Awareness. *International Journal of Educational Psychology*, *7*(2), 94–122. <https://doi.org/10.17583/ijep.2018.2789>

Study III Kallio, H., Kallio, M. Virta, K., Iiskala, T. & Hotulainen, R. (2020). Teachers' Support for Learners' Metacognitive Awareness. *Scandinavian Journal of Educational Research*, 1–17. <https://doi.org/10.1080/00313831.2020.1755358>

Within all three articles HK contributed to the study conceptions and designs; data collections, analyses and interpretations and was responsible for the writing of the manuscripts. The co-authors revised the manuscripts for submissions and publications.

1 Introduction

The purpose of this doctoral thesis is to deepen existing understanding of teachers' metacognitive awareness (MA). The main aims are to explore MA and to study how teachers specialized in different fields of education support their learners' MA on two different educational levels. The dissertation's aims were theoretical, methodological and empirical in nature. The specific aims of this dissertation were to extend the concept of MA, to examine how an individual's perceived MA can be categorized, especially from the point of view of teacher support, and finally, to develop methods to capture and to analyze teacher support for learner MA.

MA is often used as a synonym with the concept of metacognition (see Schraw & Dennison 1994; Schraw & Moshman, 1995), described as an awareness of one's own thinking and strategies used. Metacognition is generally defined as the knowledge of one's own cognitive processes (Flavell (1979, p.232) and as the activity of monitoring and controlling one's cognition (Ormrod, 2004, Young & Fry, 2008). Although the topic has been a long-standing issue in the field of education, it has only recently begun to attract increased attention from researchers, educators and policymakers as countries like Finland have introduced it as a central element of their reformed curricula. Various pedagogical literature now instructs teachers to pay attention to MA in learning. Even if the metacognitive dimension of teacher professionalism is considered crucial (Messmann, Mulder & Gruber, 2010), research on teacher MA is in scant supply (Bulut, 2018), especially on teachers' support of learner MA and the MA of in-service teachers. Research on pre-service teacher MA does exist to some extent.

However, research related to in-service teachers' professional development in general is abundant (e.g. Walter & Briggs, 2012; Aldahmash, Alshamrani, Alshaya & Alsarrani, 2019). Several authors (e.g. Hopkins, 1993; Fishman & Mc Carthy, 2000) cluster the goals and purposes of teacher research around two key emphases: enhancing the professional role of teachers and improving the quality of learning in classrooms. This study relates to the latter, focusing on exploring more implicit aspects of learning and teaching, such as perceived MA. According to the findings of a study by Messmann, Mulder and Gruber (2010), knowledge of cognition is one of the most important predictors of innovative work behavior inside the classroom.

To look at research in terms of understanding MA of and within different teacher education systems and contexts (see Clandinin & Husu, 2017, pp. 6), this study's findings on individuals' MA aim to contribute towards further reformation of teacher education to make future learners better equipped with 21st century skills.

Educational studies emphasize the importance of teacher support (Cox & Williams, 2008; Patrick & Ryan, 2005; Ryan & Patrick, 2001), because it forms the base for learners to reflect on their own learning (Bowlby, 2012, Roorda, Koomen, Spilt & Oort 2011; Wentzel, 1997). However, the definition of support varies among researchers. Common to the definitions in educational research is the nature of the effort of trying to help the learner in their process of learning. The findings of empirical studies support the claim that MA acts as a notable predictor of academic achievement (Anderson, 2001). Teacher support carries crucial importance in learners' academic success (Johnson, Johnson & Anderson, 1983; Patrick, Ryan & Kaplan 2007; Roorda et al., 2011; Ryan & Patrick 2001).

The international trend of emphasizing students' responsibility over their own studies highlights the importance of being more aware of and understanding one's own learning, at all levels of education. A deep understanding of the complex issues of metacognition must first exist in teachers in order to be able to support MA among learners. Along with other 21st century skills, metacognition has been highlighted as one of the most important aspects of learning on new reformed curricula in many countries like Finland, New Zealand, USA, UK and other countries of the Organisation for Economic Co-operation and Development (OECD) (OECD, 2019). Although there has been research focused on students' MA, teacher MA is still an area of research that has been scarcely studied. More precisely, research on how teachers support their students in using and enhancing MA in learning is needed.

The question of learners' responsibility over their own studies and their learning to learn has often been raised in the recently expanded educational discussion. The question of how one learns to learn and to understand and regulate one's learning continues from childhood to adulthood and requires MA to be answered. According to the present national core curriculum of general education (GE) drawn up by the Finnish National Board of Education (FNBE) (2016), the learner is to be viewed as an active actor irrespective of their age. In the curriculum, the importance of learning to learn skills is emphasized as a foundation for lifelong learning. The secondary vocational education curriculum also states that attention must be dedicated to lifelong learning skills during studies. A personal development plan, including individual learning methods, is to be drawn up together with the student at the beginning of their education (FNBE, 2016.)

The weight value of learning to learn, along with the regulation of one's learning, and hence, the value of MA, are substantial in the objectives of both GE and Upper Secondary education, as well as in the compilation of students' individual

development plans. Furthermore, new educational political definitions and plans give reason to examine the matter more thoroughly. For example, the Finnish Government, in power since June 2019, is preparing legislation to make secondary education compulsory for everyone under the age of 18 (Finnish Government, 2019). Meanwhile, concern for students' ability to learn has been growing in recent years. Teachers, parents and learners themselves have all taken a stance on whether the trend of the new educational policy is reasonable or even feasible. A particular concern is raised repeatedly in the writings over whether teachers have sufficient resources to support their learners. Criticism is often directed at the demands that learners should take responsibility for their own studies and be able to self-direct their learning, a perspective considered too demanding by the critics.

However, teachers have already been urged to encourage learners to self-direct and self-regulate their learning, and to take responsibility for their own studying, for decades. In the current national core curriculum for GE (FNBE, 2016), the development of learning to learn skills is regarded as the bedrock of target-oriented and life-long learning. This core curriculum also informs teachers that helping learners find their own ways of learning and becoming aware of their learning processes promotes self-directed learning. The key is to strengthen the teachers' own MA. It is extremely important that teachers have the ability to estimate their own support activity relative to the starting points of different learners during the learning process. In this dissertation, these questions are examined according to the theory of MA.

In response to the ongoing discussion on the need to study how learners' metacognitive aspects can be enhanced, this dissertation aims to fill the gap between two sectors of education: GE at the lower secondary level and Vocational Education and Training (VET) at the upper secondary level. The two are linked closely together, as the basis for learners' studies is formed in GE. The goal of VET in Finland is to improve the skills of the work force, to respond to the skills requirements of the working world and to support lifelong learning (FNBE, 2015). To achieve these goals, learner self-evaluation and teacher MA are required to support the students in the demanding processes of growing. Hence, it is highly important to develop the scientific discussion of MA in the field of educational research, particularly since vocational education has recently been re-organised in many countries, including Finland. In Finland, the Ministry of Culture and Education recently reformed legislation on the provision of education and simultaneously reduced education funding by 200 million euros. Education providers were instructed to improve their administration and learning culture as the new law and new legislation on vocational education (HE/39, 2017) came into force on 1.1.2018. The reform has aroused criticism as it is seen as controversial from the learners' perspective. It has been argued that the new legislation and funding cuts have led to

a reduction in lessons, less traditional contact teaching, and more responsibility being placed on students with the application of modern teaching methods and learning styles, changing the direction towards 'learning to learn' and 'self-directed studying' trends. For teachers, this has meant adapting to a new, more supporting role in a learner-centred educational culture, in which MA is becoming an increasingly important asset in learning. Furthermore, these abilities will be required more and more often in working life, calling for lifelong learning skills. Teachers' support in enhancing learner MA is therefore crucial in this new educational culture.

1.1 The multifaceted nature of metacognitive awareness

Metacognition has been widely studied from different perspectives and within a variety of fields for over forty years. Empiric studies show that metacognition is multifaceted and multidimensional (Efklides, 2008; Schraw, 2001). However, unanimity on the definition of metacognition is yet to be reached.

According to Schraw and Dennison (1994, see also Schraw & Moshman, 1995; Balcikanli, 2011), MA means being aware of one's thinking and the strategies one is using. Marton and Booth (1997; 2013) pay special attention to how awareness is defined. They describe the term "awareness" as a phenomenon which manifests itself in variations of the ways in which people experience situations and phenomena in their lives and worlds. Ways of experiencing things are described in terms of the structure of awareness, a word used synonymously with consciousness. According to Lehtinen, Vauras and Lerkkanen (2016), experiences of situations and phenomena are connected to the person's know-how of a related thematic entity, problem or operation, and hence should not be evaluated in terms of the learning which has taken place only during a certain studying event. In this dissertation, following Marton's and Booth's (1997; 2013) and Lehtinen et al.'s (2016) definitions, the term awareness is described as a personal ability of being conscious and of understanding and specifying understanding of one's thinking of the situations and phenomena where learning is concerned.

The definition of MA can become controversial, if the term should be used to describe thoughts which were metacognitive once but have later, as a result of continuous use, become unconscious and automatic (Williams & Atkins, 2009; see also Efklides, 2009). It is important to note that thoughts of unconscious and automatic nature are not considered a part of MA. Hacker, Dunlosky and Graesser (2009) define MA as a wide consciousness in which thinking is directed at oneself as an actor within a certain environment and thus increases awareness of the thinker's own features. This kind of conscious and intentional thinking with other thoughts as the object, can be not only potentially commanded or controlled by the experiencing

person, but can also be recorded and therefore made accessible to the researcher (see also Carr, Alexander& Folds-Bennett, 1994: Paris & Winograd, 1990).

Research in metacognition has mainly focused on identifying what people know about their own cognition (knowledge of cognition) and how people monitor and control their cognition (regulation of cognition) (e.g. Flavell, 1979; Brown, 1987; Schraw & Dennison 1994; Schraw & Moshman, 1995; Ormrod, 2004; Meijer, Veenman, & van Hout-Wolters, 2006; Young & Fry, 2008). This two-component model of metacognition, knowledge of cognition (i.e. metacognitive knowledge) and regulation of cognition (i.e. metacognitive regulation), has received approval from researchers and has been widely used. Common to research in the field of metacognition is that it is defined as a conscious process of thinking of the processes of controlling and monitoring cognition. Nevertheless, there are also studies in which metacognition is defined as and associated with both the conscious and the unconscious level of thinking of thinking (Eflkides 2008, Reder & Schunn, 2014). A distinction between explicit and implicit metacognition is also used in drawing the line between levels of consciousness in the field of metacognition (Greenwald & Banaji, 1995; Wilson, Lindsey, & Schooler, 2000; Son & Kornell, 2005; Petty & Briñol, 2006). In some studies (e.g. Koriat & Levy-Sadot, 2000), attention is also paid to the connection between a person's emotions and metacognition. In this study, unconscious metacognition and thinking related to emotions have been deliberately ruled outside the theoretical framework. Instead, explicit MA, which includes a person’s perceived consciousness of metacognition, the ability to understand and specify one’s thinking of learning, is studied. In order to avoid confusion between two synonymous concepts, MA is used instead of the term metacognition.

The domain general character or domain specificity of metacognitive awareness

MA is an important element in learning and crucial to the development of learner autonomy (Cornford, 2002; Wenden, 1991; Wilkins, 1996). According to Schraw and Dennisson (1994, p. 460), MA enables a person to plan, sequence and monitor one’s learning so that improvements translate directly into their performance. It is also important to consider how features related to MA vary between teachers and therefore, between domains.

Discussion over whether MA is domain-specific or domain-general in nature has been raised in research literature. Consensus is especially lacking over the extent to which components of MA are considered to be general or domain-specific (Veenman et al., 2006). Since the majority of study on MA is aimed at domain-specific study in subject areas such as biology or chemistry, or most commonly in mathematics and literacy (Desoete, Roeyers & De Clercq, 2003; Kramarski & Mevarech, 2003), it is

often suggested that metacognitive skills are primarily demonstrated within a subject domain and are not modelled as easily adaptable or transferrable skills. As studies with different views on the nature of MA exist, it is inevitable for contradictory interpretations to appear.

According to Schraw (2001), MA is teachable, domain-general and flexible in nature and therefore, a very important phenomenon particularly in new areas of learning. Wolters' and Pintrich's (2001) research supports Shraw's argument to some extent. Even though research on the definition has usually concerned children beyond the age of 15 (cf., Veenman & Beishuizen, 2004; Veenman & Spaans, 2005; Veenman, Wilhelm & Beishuizen, 2004), the development in MA occurs especially between the age of 14 and 15 years, when metacognitive skills generalize across tasks and domains (Veenman, 2015).

Pintrich (2002) emphasizes the importance of using and teaching knowledge of cognition as a part of MA by arguing that it should be embedded within the usual content-driven lessons in different subject areas. According to him, one of the most important aspects of teaching is to label MA explicitly for the learners, which will help them connect the new strategies to existing knowledge on learning strategies. According to Hacker et al. (2009), if people are taught MA concerning the utility and function of a strategy, they are more likely to generalize the strategy and apply it in new situations. Evidence of the generality of the phenomena across different tasks and domains exists (see Schraw, Dunkle, Bendixen, & Roedel, 1995; Veenman & Verheij, 2001; Veenman et al., 2004), proving MA to differ from the character of domain specific cognitive skills (Schraw, 2001). Therefore, metacognitive activity need not always be task-specific (Meijer et al., 2006). This supports the thought that it is extremely important to develop MA throughout one's entire studying life. When MA is treated as domain general and thus developed, learned and flexible, it will help in all learning without having to look in detail at the field or context it belongs to. As MA appears to be more durable and general than domain encapsulated cognitive skills (Schraw, 2001), it is therefore an essential part of the life-long-learning trend in pedagogics (see Bulut, 2018) and strongly supports its position in 21st century learning (see Dede, 2010; National Research council, 2013).

Self-regulated learning

In research literature, the conceptual distinction between metacognition and self-regulated learning (SRL) is bidirectional. The terms have been used interchangeably (Veenman, 2007) because of their conceptual and operational definitions (see Dinsmore, Alexander, & Loughlin, 2008). Researchers' views differ depending on which theory is used as a starting point. In studies on metacognition, researchers consider self-regulation to be a subordinate component of metacognition, whereas

SRL researchers regard it to be superior to metacognition in conceptual order (Veenman et al., 2006). In literature on teaching and teachers, many educators prefer the term self-regulation (e.g. Perry, Phillips & Dowler, 2004; Winne & Perry, 2000; Zimmerman, 2000; Zimmerman & Schunk, 2011). Therefore, the concept of MA would be incomplete without consideration of SRL, since they are often discussed concurrently (Hacker et al., 2009; Schraw, Crippen, & Hartley, 2006).

Self-Regulated Learning Theory (SRLT) describes the relationship between cognition and metacognition (Schraw & Dennison, 1994). Many models of SRL exist (e.g., Pintrich, 2000; Winne & Hadwin, 2008; Zimmerman, 2000; Greene, Costa, & Dellinger, 2011). Bandura (1977) defines self-regulation as the ability to control our own behaviour. According to Zimmerman (1989), all models of SRL assume that learners are aware of the potential usefulness of these self-regulatory processes in enhancing their cognitive performance (see also Bråten, 1991b). Schoenfeld (1987) includes self-regulation as a component of metacognition. The terms “metacognitive regulation of learning” and “self-regulation of learning” have similar content (Vermunt & Verloop, 1999). Even though a majority of the models of SRL serve the idea of operations such as planning and monitoring during learning, there is no strong supposition of different phases occurring hierarchically (see Azevedo, 2009; Ainley & Patrick, 2006; Pintrich, 2000; Winne & Hadwin 1998).

In this dissertation, as in the theory used in research of MA, the component of SRL is subordinate to MA. It is taken into account due to its important role in MA and learning to learn research. Particularly, along the aims of this dissertation, to deepen the understanding of teacher MA as part of teachership and to develop teacher education, MA needs to be reconsidered and studied rigorously.

The components of metacognitive awareness

In educational research, the concept of metacognition is often used as a synonym for MA (see Hacker et al., 2009; Balcikanli, 2011; Lai, 2011; Thompson & Johnson, 2014; Martinez & Davalos, 2016). However, there are some differences in how its theoretical structure is defined. As MA has its roots in metacognition, a description of the components is presented next to clarify the basis of the theoretical structure.

Literature reviews from Flavell (1976) until later research (e.g Bråten, 1991a; Dinsmore et al., 2008; Veenman et al., 2006; Whitebread et al., 2009) have studied metacognition and defined its components. In the field of metacognition research, there are considered to be two main theoretical frameworks that are based on Flavell's (1976, 1979) and Brown's (1978) theoretical perspectives. Flavell (1979), emphasizes knowledge of cognition, dividing it into sub-components of knowledge of cognition (see also Peverly, Brobst, & Morris, 2002; Veenman & Spaans, 2005)

whereas Brown (1987) emphasized knowledge of cognition and regulation of cognition.

Flavell (1976, p. 232) first defined metacognition as the knowledge of one's own cognitive processes, dividing it into three categories: knowledge of personal variables, task variables, and strategy variables. According to Flavell (1977), knowledge of a person's variables refers to general knowledge in learning. That general knowledge refers how a human being learns and processes information, but equally to individual-specific knowledge of one's own learning processes. Flavell's second character of metacognition, knowledge of task variables, refers to knowledge about the character of the task but also to the type of processing done by the individual. The third component, knowledge of strategy variables, includes knowledge of cognitive and metacognitive strategies, as well as conditional knowledge about when and where to apply them (see Bråten, 2006). These knowledge components of metacognition can be theoretically separated into independent components. However, according to some researchers, different components of MA have been reported to interact with each other (e.g. Efklides, 2006).

In addition to the component of knowledge of cognition, following Brown's (1987) theoretical framework, the component of regulation of cognition is regarded as one of the main components of MA by many researchers (see Brown, Bransford, Ferrara, & Campione, 1983; Schraw & Dennison, 1994; Schraw & Moshman, 1995; Young & Fry, 2008). Hence, a general distinction in MA research is made between these two main components. As this theoretical framework has been used as the basis of this doctoral thesis, the components of the theory are presented next.

Knowledge of cognition

In Brown's commonly used model (1978), knowledge of cognition (see Brown, 1987; Schraw & Moshman, 1995; Schraw & Dennison, 1994; Jacobs & Paris, 1987; Young & Fry, 2008) is comprised of three kinds of knowledge: declarative, procedural, and conditional knowledge. Schraw and Moshman (1995, p. 352) describe declarative knowledge as "knowing about things", procedural knowledge as "knowing how to do things" and conditional knowledge as "knowing why and when to do things". Schraw et al., (2006) describe these sub-components in a similar fashion. Declarative knowledge is knowledge about the contents of learning, that is, a person with declarative knowledge possesses strategies that can be applied to increase performance for completing tasks (see also Schraw, 2001). Procedural knowledge, on the other hand, is knowledge about how the person uses learning strategies to complete the task. The development of declarative knowledge is crucial for self-evaluation (Schraw et al., 2006), since a person who possesses strong

declarative knowledge is capable of utilizing their strengths and addressing their weaknesses during academic performance. Conditional knowledge is knowledge about when and why to use strategies for accomplishing tasks (Schraw, 2001), and understanding and applying strategies to enhance learning (Schunk & Zimmerman, 1998). According to Schraw et al. (2006), an individual with high conditional knowledge can monitor their learning progress and implement learning strategies effectively for context specific situations (see also Schraw, 1998).

In this study, knowledge of cognition is trated as one component of MA. Although individuals benefit greatly from their awareness of knowledge of cognition, it is still not enough to be able to control and to be aware of the entire learning process. Therefore, accurate knowledge about the required skills of regulation of cognition is needed (see Alexander, 2003; Schunk & Zimmerman, 2006).

Regulation of cognition

Regulation of cognition refers to the steps that a person takes to regulate and modify the progress of their cognitive activity. For example, the flexible employment of different processing activities, depending on circumstances and on interim learning outcomes. For teachers, it is a decisive factor in their ability to adapt, which helps them solve problems involving information management and reasoning (Hartman, 2001; Kramarski & Michalsky, 2009; Lin, Schwartz & Hatano, 2005).

The progress of the learning process is described in parallel with the regulation of cognition in educational literature. According to Vermunt and Verloop (1999), regulation activities consist of planning before a certain learning task and monitoring as well as using information management strategies while performing the task (see also Pintrich, 2004). Regulation of cognition is also considered to include the steps taken by the learner when regulating and modifying the progress of one's individual cognitive activity. According to Brown and DeLoache (1983), regulation of cognition includes predicting actions and events, monitoring ongoing activity, checking the results of actions, reality testing, and a variety of other behavioral patterns for coordinating and controlling deliberate attempts to learn and solve problems. Veenman et al., (2004) argue that regulation of cognition appears to be highly interdependent. Deep orientation, systematic orderliness, accuracy, evaluation and elaboration may be regarded as skillfulness in the regulation of cognition (Veenman, Prins, & Elshout, 2002). Furthermore, Veenman et al. (2004) found that, with some limitations, this kind of skillfulness can be regarded as a general, person-related characteristic across age groups, rather than being domain specific.

In research of MA, two different models of the components of regulation of cognition have been referred to most often. The five sub-component model includes components facilitating the process aspect: planning, information management strategies, monitoring comprehension, debugging strategies and evaluation (Schraw & Dennisson, 1994; Baker, 1989). In addition to this theory of MA components, a reduced model has been utilized, which includes activities of orienting/planning before a certain course or assignment, monitoring/testing/diagnosing and adjusting during the learning task or course, and evaluating/reflecting on one's own learning at the end of the learning task or course (see Vermunt & Verloop, 1999). Hence, even though a number of theoretically and empirically tested metacognitive regulation skills have been described in research literature, there are three components that are mentioned repeatedly: planning, monitoring, and evaluation (Jacobs & Paris, 1978; Schraw & Dennisson, 1994).

According to Schraw (2001), the term planning means a person's ability to set learning objects, select appropriate strategies and allocate resources to accomplishing tasks. In describing an active process of elaborating, summarizing, and focusing on important information for mental restructuring concerning the learning task, the term information management is used (Pucheu, 2008). Monitoring is used to describe a person's comprehension and ability to assess one's cognition and strategy effectiveness (Schraw, 2001). When identifying and correcting errors concerning implemented strategies occurs, the term debugging is used to describe the activity.

The concept of evaluation, which is usually referred to as a sub-component of regulation of cognition (see Jacobs & Paris, 1987; Schraw & Dennisson, 1994; Balcikanli, 2011) can be defined and understood in different ways. In research on MA, evaluating refers to appraising efficiency of one's learning. Usually the focus is on re-evaluating one's goals and conclusions. It is commonly assumed that knowledge of cognition and regulation of one's learning strategies such as planning are associated with the evaluation of one's learning (see Baker,1989; Schraw, 2001). However, the definition of evaluation depends on its targets and even more importantly on who has set them. In some connections, it refers to controlled evaluation, for example institutional or teacher-led school evaluation. In this form the evaluation is external, and it does not fulfil the self-directing criteria of the evaluation of the learner. In this dissertation, the term evaluation refers to self-evaluation, directed at the learner's own objectives and the regulation of one's learning. Overall, special attention is paid to the component and therefore, its definition needs to be carefully examined.

Self-evaluation is generally referred to as one of the regulative activities of learning, particularly at the end of the learning task (Schraw & Dennisson, 1994; Vermetten, Vermunt, & Lodewijks, 1999). According to von Wright (1992), self-

evaluating pertains to judging the extent to which the final learning outcomes agree with the goals that were set. It also pertains to the degree to which the learning process has proceeded as planned. Hence, the self-evaluation of one's own learning is the central component in the entity of MA. Previous research aligns self-evaluation with the regulation of metacognition (Jacobs & Paris, 1987; Schraw & Dennison, 1994; Balcikanli, 2011). In this dissartation, the term evaluation refers to the self-evaluation of an individual's own objectives and is directed at the general level of the learning effort. The concept is used to avoid any misunderstanding that might arise from mixing it with the evaluation used in educational research in general. Therefore, the self-evaluation of one's own learning is the central component in MA and is explored rigorously in this dissertation.

Research on teachers' and learners' metacognitive awareness

Teacher development has been a topic of discussion in educational literacy (e.g. Pintrich, 2002; Butler, Lauscher, Jarvis-Selinger & Beckingham, 2004). Gaining knowledge on what teachers know about their teaching should become a focal point for change in this discussion. In order for a teacher to be able to understand and regulate their teaching, MA is required. Research (e.g. Baylor, 2002; Mc Cabe, 2011; Negretti, 2012) on pre-service teacher and learner MA exists. However, research on in-service teacher MA is scarce and even less study has been conducted to examine both teacher and learner MA.

Until now, little has been known about teacher MA. Studying teacher MA is also considered more complex than studying learner MA (Zohar, 2006). Whereas learners need to regulate their cognitive activity, teachers have an additional array of different tasks concerning learning and teaching, such as how to identify appropriate strategies, make rapid decisions, adjust for learners' individual differences, and so on (Duffy, Miller, Parsons & Meloth, 2009).

Research on teacher MA has been mainly based on relatively small samples of pre-service teachers. This dissertation concentrates on expanding knowledge of the topic in general by collecting data from a larger sample of in-service teachers. For this purpose, this dissertation gives special focus to reviewing literature on proper research methods. In the study of Balcikanli (2011) *The Metacognitive Awareness Inventory for Teachers* (MAIT) was developed, which confirmed the assessment of MA related to teaching. Based on Brown's (1987) two-component model of metacognition, the 24-item questionnaire was composed of the components of knowledge of cognition and regulation of cognition, with each component consisting of subcomponents. The theoretical existence of eight subcomponents of metacognition was confirmed: declarative knowledge, procedural knowledge, conditional knowledge, planning, information management strategies, monitoring,

debugging strategies, and evaluation of learning. The final factor loading was based on six factors including declarative, procedural, and conditional knowledge in knowledge of cognition, and activities such as planning, monitoring, and evaluation in regulation of cognition.

With the MAIT, Balcikanli (2011) studied the MA of pre-service teachers of English Language. The MAIT was also used in a study by Ghonsooly, Khajavy and Mahjoobi (2014) to study the predictability of teacher trainees' academic achievement, based on their scores in MA and self-efficacy. Together with the MAIT, the instrument of Teachers' Sense of Self-Efficacy Scale (TSES) (Woolfolk & Hoy, 1990) was used in the study. According to the results of the path analysis, both MA and self-efficacy have an influence on academic performance, with MA having a stronger effect. Moreover, no differences were found between the MA or self-efficacy of female and male subjects per the results of the t-test. The results of Mai's study (2015), in which the MAIT was used to collect the data, disclosed that science teachers have a high level of perception about their MA. There were no statistically significant differences related to teachers' gender or age according to the results.

Another well-known questionnaire for collecting data to study teachers' perceived MA is *The Metacognitive Awareness Inventory for Adults* (MAI) by Schraw and Dennison (1994). This measurement is a 52-item self-report instrument of adolescent and adult MA. The questionnaire was created to confirm the theoretical existence of two components: knowledge of cognition and regulation of cognition, which were quite close to each other. The final factor structure was best represented by dividing the factors into eight subcomponents: conditional knowledge, declarative knowledge, procedural knowledge, planning, monitoring, information management strategies, debugging strategies, and evaluation of learning, respectively. This structure was also confirmed by the results of Sperling, Howard and Murphy, (2004). The reliability and the validity of the MAI has been studied to confirm its utility.

Hughes (2017) investigated the MA of teachers of technology and engineering during specific established teacher practices with a semi-structured, open-ended interview. The MA interview was modelled after the components and subcomponents of the MAI. The findings of the study indicated that teachers (N=18) had similar levels of MA in the knowledge of cognition component but had uniquely different levels of MA in the regulation of cognition component. Moreover, research indicates that teachers' knowledge of cognition is linked to their learning ability, pedagogical effectiveness, ability to transfer learning from one context to another, and ability to adapt to a complex educational environment. Asy'ari, Ikhsan and Muhali (2019) studied pre-service teacher MA in learning, aiming to explore the effectiveness of the inquiry learning model and the consistency of the inquiry

learning model's impact. They used the MAI questionnaire to collect data on MA in the study, including eight aspects of MA, i.e. declarative knowledge, procedural knowledge, conditional knowledge, planning, information management, monitoring, debugging and evaluating.

The participants of the study were 90 prospective student-teachers from the Faculty of Mathematics and Science Education, IKIP Mataram, Indonesia, distributed into three groups by using saturated sampling. The results of the study revealed that pre-service teacher MA is related to activities that help control one's mind and learning. The results indicated also that the inquiry learning model used has a substantial impact on increasing pre-service teacher MA in learning, due to its focus on the process of thinking that builds experience by involving oneself actively in learning (see Kuhlthau & Todd, 2007). In Stephan's study (2017), pre-service teachers' ability to foster students' MA was studied. She argues that in order to impact students' MA growth, teachers must provide quality metacognitive focused feedback to deepen the students' capacity for in-depth and self-regulated learning. For school districts, she sees the lack of assessment tools to measure this kind of ability as problematic. According to the researcher, since there are no existing interview tools to intentionally assess pre-service teachers' ability to foster students' metacognitive growth, research on the matter is needed.

In Koc's and Kuvac's study (2016), the MA levels of pre-service science teachers were determined. The MAI and Personal Information Form (PIF) were utilized as data collection tools. According to the results, the MA levels of pre-service teachers were generally found to be high. The results between the main components of MA revealed that in knowledge of cognition, mean scores from both declarative knowledge and conditional knowledge were found to be higher than in procedural knowledge. In the regulation of cognition, the highest scores were found in debugging and the lowest score in evaluation. The researchers concluded that overall, the MA levels in strategies and methods were found to be lower when compared to the MA levels of knowledge about why and when to use a particular strategy and method. Some researchers have also compared pre-service teacher MA between genders. In the studies of Bogdanovic, Obadovic, Cvjeticanin, Segedinacve and Budic (2015) and Kilinc (2013), MA levels of female students were found to be higher than the MA levels of male students. Koc and Kuvac (2016) found no differentiation in the main components of knowledge of cognition and regulation of cognition between the genders. However, a statistically significant difference was found in the debugging sub-component, in favor of females. Studying the sub-component scores of MAI by grade level, Koc and Kuvac (2016) found statistically significant differences outside the factors of conditional knowledge and debugging, as well as in the evaluation sub-component, favoring senior pre-service science

teachers. Also, in Ozsoy's and Gunindi's study (2011), senior per-service teachers' MA has been found to be higher than the MA of freshmen.

The MAI has been used in several researches to study learner MA. According to Young and Fry (2008), who studied the relationship between MA and academic achievement in college students, the results support the validity of the MAI's relation to academic measures. Zhang (2010) also confirmed the reliability and validity of the MAI in a study where the predictability of metacognition was investigated, while also taking self-rated abilities into account. Therefore, the MAI was considered to fulfill the requirements of validation and further studies for examining learner MA in Study II.

Several researchers have used the MAI to study MA, especially through the theoretical model of the main components, knowledge of cognition and regulation of cognition. In the study of Hammann and Stevens (1998), it was found that college students' (N=90) predictions of test performance, test scores, and online measures of exactness of responses were correlated with their knowledge of cognition. The regulation of cognition was related to intrinsic goals orientation and task value. The idea of the MAI was used in a study by Panaoura and Philippou (2003), which was part of a larger research on the development of young learners' metacognitive ability in mathematics, where the original state of an instrument's development and the examination of its construct validity were presented. In their study, the existence of a second-order structure representing metacognition was verified by a confirmatory factor analysis, as well as two basic first-order factors indicating knowledge of cognition and regulation of cognition. Furthermore, the MAI has been used to obtain scores for individual areas of MA (Coutinho, 2007) and to study academic achievement in college and to study confidence in academic achievement (Amzil & Stine-Morrow, 2013). It has also been used as an instrument in studying students' strategy use and understanding (Hartley, 2001; Lee, 2013; Mair, 2012), as well as activity-based learning and metacognition-based activities (Pang, 2010). Moreover, the MAI has been used to study college students' self-monitoring and problem-solving skills, aiming to find out how to support these skills (Kauffman, Ge, Xie, & Chen, 2008; Lee, Teo, & Bergin, 2009).

In the research of Seraphin, Philippoff, Kaupp & Vallin (2012), both teachers and students participated in studying the impact of professional development on MA and learning in science education. The results of the analysis suggested that the ability to evaluate cognitive strengths and weaknesses is possible among teachers and students and that they can learn to use that knowledge strategically. Both novice and experienced teachers benefited from an MA-focused scientific inquiry in their professional development. The results also suggest that teachers need to be supported in their MA development. This is in line with the basis of this dissertation and hence, encourages to study the topic further as per the implications of Study III.

1.2 Teachers' support for learners' metacognitive awareness

The importance of teachers' support is highlighted in educational studies (Cox & Williams, 2008; Patrick et al., 2007; Ryan & Patrick, 2001). One of the teachers' main objects is to facilitate the learner to achieve academic results. The findings of the empirical studies support the fact that MA composes a substantial predictor of academic achievement (Anderson, 2001). The support given by the teachers is a comprehensive phenomenon, aimed serving the learners' best academic interest. How and in what areas the teachers support their learners, can be examined from different points of view, as researchers determine support differently. The conclusion that the teachers' support affects the learners' achievement in prominent ways is common to earlier studies (Cornelius-White, 2007; Roorda et al., 2011.) Teacher support creates a solid base for their learners' studying and reflecting on their own learning (Bowlby, 2012; Roorda et al.2011; Wentzel, 1997.)

Teacher support carries crucial importance in a learner's academic success (Johnson et al., 1983; Patrick et al., 2007; Roorda et al 2011; Ryan & Patrick 2001). When learners are supported by their teachers, they are also more likely to reach higher academic success (Patrick et al., 2007; Roorda et al. 2011; Ryan & Patrick 2001; Furrer & Skinner 2003). According to Johnson et al. (1983), the support given by teachers can be divided into two principal factors: academic support (supporting students' academic endeavors) and the teachers' support which is directed at the learners' person (personal support - supporting students' personhood). In this study, personal support is not studied as a part of the concept of support. The focus on the teachers' support for the learners' MA is in academic activities, learning orientations and conceptions of learning (see also Vermunt, 1996; Vermunt & van Rijswijk, 1988; Entwistle & Peterson, 2004; Vanthournout, Donche, Gijbels, & Van Petegem, 2010). This line is also supported by the study of Kim, Dar-Nimrod and MacCann (2017), which showed that the teacher´s personality does not predict – against the researchers' expectations – academic achievement.

The research in this dissertation will be targeted at teachers' perceived awareness of the operations of helping their learners to think and to understand their own learning at an MA level. The support activity can be directed either at a whole teaching group or at an individual learner. In research literature two concepts are used when examining a teacher helping a learner. The question of whether the concept of "support" or "scaffold" is used is not answered at a general level but situation-specifically. The definition of the concepts is not at all unambiguous because neither of the operations can be clearly outlined and are not mutually exclusive. Furthermore, scaffolding or supporting never look at different situations in the same way, nor can they be adapted into every situation in the same way. (Van de Pol, Volman & Beishuizen, 2010.) Many pedagogical studies have been

conducted on both phenomena lately. The overlap of the definitions can be found in research literature and it is important to understand what is meant by them in different contexts.

Concept of support

This dissertation aims to study teacher support for learner MA. Therefore, the following issues are necessary to consider when referring to a definition of support. The concept of "scaffolding*"* is often used to describe operations during the process of continuous learning. However, it has at times been used too generally to describe specific help for students' learning (Puntambekar & Hübscher, 2005). The same thing has also happened in using the word "support". Therefore, it is necessary to carefully define how the phenomenon can be described and analyzed in different components and items depending on the target of study. Both "scaffolding" and "supporting" can be divided into parts for the purpose of research in teaching. In this study, the concept of "support" is used over "scaffold" as the main concept in describing teachers' operations in enhancing learner MA.

Both the supporting and scaffolding of learning can contain both cognitive and metacognitive elements and functions. According to Meijer et al. (2006), metacognitive activity is essential in the strategic application of knowledge of cognition to achieve cognitive goals. When the act of helping a person in their learning process is meant to be described widely and comprehensively, the concept of "support" can be used. This can be directed towards one learner or it can apply to a whole group of learners. The term "scaffolding" is widely used today in educational studies, as well as "supervising", a popular term among some scholars. "Scaffolding" is often used to describe direction at the individual level, in which a learner is personally helped phase by phase to build one's own understanding of the matters which are related to their studying (e.g. Kajamies 2017; Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014: Van de Pol et al., 2010). Scaffolding happens in parallel with the learner's learning process, through the teacher's interaction with the student, decreasing gradually as their skills improve. Careful, on-going calibration and long-term scaffolding is especially needed when the teacher tries to help learners with learning difficulties (Kajamies 2017). Teacher-learner interaction has been widely studied. There are some studies concerning the assessment of scaffolding young learners. For example, Pianta, La Paro and Hamre (2008) developed the Classroom Assessment Scoring System (CLASS), an observation method which has been widely used to explore domain-general teaching quality and teacher–child interactions (e.g., LoCasale-Crouch et al., 2007). The system has also been adopted into pre-school and kindergarten educational practices.

However, instruments to assess domain-general teacher support in MA in both GE and VET has to my knowledge been non-existent so far.

In this study, the term "perceived support" is used to describe and define the awareness of activities where a teacher is helping a learner in MA. Perceived support can be set up in an interactive situation between the teacher and learner, where the learner sets the goals for one's own learning. Hence, the learner is the one who determines the starting point for a learner-centred learning process. The role of the teacher is to follow and help the learner find the best tools and paths to complete the task and to reach the goals the student has set for themselves. The importance of perceived teacher support is highlighted in educational studies (Cox & Williams, 2008; Patrick & Ryan, 2005; Ryan & Patrick, 2001*).* The perceived support is often linked to motivation. According to Goodenow (1993a)*,* the role of perceived teachers' support plays an important role in predicting motivation (see also Ryan & Patrick, 2001; Wentzel,1997). However, in this dissertation, motivation has been marked off outside the frame of reference.

In sum," perceived support" is used in this dissertation because of the slight difference between the concepts mentioned above. While the term "support" is used by some scholars to refer to learner centred education and assistance in general, in scaffolding the teacher takes a bigger guiding role in learning situations, building buttresses to reinforce the student's ability to learn. Hence, the term scaffolding is seen to have a longer-lasting effect in the interaction between the learner and the teacher and is therefore less suitable than the term "support" in this study.

The empirical aim of the present study is to examine how teachers support learner MA, defined here as an individual's perceived understanding and conscious thinking of learning (Ormrod, 2004; Young & Fry, 2008). Along the widely used current theory of MA (Brown,1987; see also Schraw & Moshman, 1995; Schraw & Dennison 1994; Ormrod, 2004; Young & Fry, 2008), the emphasis of the study of teachers' support for MA is on the main components of knowledge and regulation. As clarified earlier, the importance of self-evaluation is highlighted in the present study and therefore, it is studied here as one of the main components. To determine the focus of the components in more detail, the main components are described here as *knowledge of learning objects, regulation of learning strategies and self-evaluation* (see Figure 1).

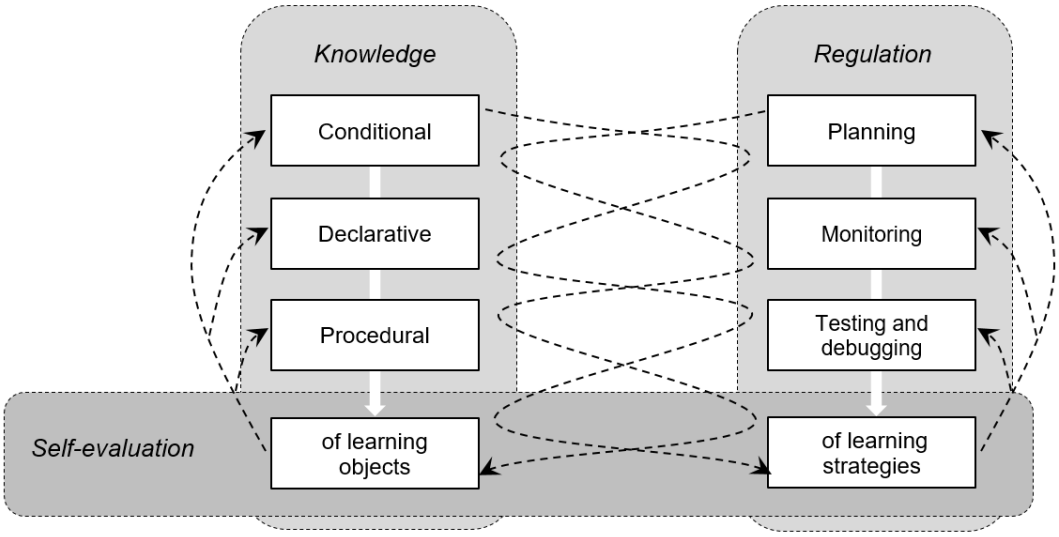

Figure 1. Teacher's support for knowledge, regulation and self-evaluation of MA.

It is obvious that no regulation can take place without having a pre-understanding of the future operation. Two pieces of information are required: information concerning objects and information concerning strategy. Which one will arrive first depends on the primary aim of learning, i.e. is the aim learning to learn, learning the target of a specific learning event or process of learning. Both the teacher and the student should be conscious of the aims of learning. Additionally, the objects and strategy of learning should both be evaluated separately in each learning event and learning process. Therefore, in this study, self-evaluation is both examined and directed with respect to the *knowledge of learning objects and regulation on learning strategies.*

1.3 The significance of metacognitive awareness in different educational domains

There is a broad theoretical and empirical consensus that MA influences learning outcomes that are strongly linked to the reflection of learning (Anderson, 2001; Butler & Winne, 1995; Efklides, 2006). Reflection of one's learning also expresses an awareness of the learning process and helps the learner oversee the process by evaluating and improving their progress in learning (Reingold, Rimor & Kalay, 2008). To achieve good learning outcomes, the learners should be metacognitively aware of their learning. In other words, they should have knowledge of how, what, when and why to study and also be able to regulate learning within different subject areas. Reaching this goal requires a realignment of teachers towards a more supporting role to help students improve their learning. MA plays a crucial role in

all phases of learning (see Livingston, 1997; Virta, 2005) and should be emphasised at every educational level in response to 21st century skills (Dede, 2010; National Research council, 2013). In this dissertation, teachers' perceived MA was studied among different teacher professions in general education (GE) and vocational education and training (VET).

The time of transition between GE and VET is highly important period for learners as it has remarkable impact on an individual's MA development as part of a learner's growth journey from youth to early adulthood (see Veenman, 2015). Therefore, teachers in GE and VET have a substantial role in helping the learner become rooted in the basics of MA during this period. The ways in which the results of this study can be utilised to direct education within different domains will be discussed in Chapter 6. Teacher education exists on a diverse spectrum of different education programs, practices, and contexts. Thus, it can be assumed that across different periods of time, teacher education has laid emphasis on different areas (see Clandinin & Husu, 2017, p. 6) regarding the conception of knowledge, as well as concepts of learning and teaching based on diverse learning theories (Mena, Hennissen & Loughran, 2017). Moreover, there can be differences between and within different groups of subject teachers over perceptions of how the learner ought to be supported in their MA. Since the characteristics and contents of different teacher educations at different levels and domains vary from each other, the educational sectors of GE and VET that participated in this thesis are shortly presented and discussed in this chapter.

In the study of MA, it has been discussed whether the character of MA is more domain-general or domain-specific in nature (Schraw, 2001; Veenman et al., 2006). Based on this study, it can be assumed that subject teachers are not necessarily a uniform group and therefore, examining them separately as subject groups concerning their perceived MA would be interesting. Moreover, if there are differences in perceptions of supporting learner MA, the relevant question would be whether they are due to the contents of the different teaching subjects or something else. As no studies concerning these questions could be found, a research gap exists. Therefore, even though the main purpose of the present thesis was not to compare different subject teachers but rather education at different levels and domains, it was highly interesting to try to clarify whether some differences could be found. The assumption of possible variations of perceptions of MA among different subject teachers is partly based on studies on subject teachers' assumptions of learning to learn and hence, possibly of MA. Namely, in the study of Stodolsky (1993), it was found that subjects could determine the assumptions teachers have about teaching and learning. Boulton-Lewis, Smith, McCrindle, Burnett and Campbell (2000) also found that the subject taught by the teachers might have an influence on their vision

of learning to learn. According to these findings, it can be assumed that there might also be differences in support for learner MA between different subject teachers.

It has been argued that one of the primary goals of education is to foster students' understanding of their learning (Greene, Costa & Dellinger, 2011). Teacher MA is required to achieve these goals and to support their students in the demanding processes of growing. Hence, more research focused on teachers' contribution in MA development is needed (Seraphin et al., 2012). A review of recent literature (Wilson & Bai, 2010) confirms that teachers' own MA would strengthen learners' knowledge of cognition, equipping the learners toward calibrating and self-regulating their learning, leading to higher student achievement. Therefore, teachers' awareness of their own metacognition is key in understanding the importance of the support for their learners' MA.

Teachers in different educational domains

Discussion on the need for teachers' MA and the domain-specific or domain-general nature of MA is often linked to teachers' professional development and job description in different educational domains. According to Bybee and Loucks-Horsley (2000), professional development provides the opportunity for different teachers to come to understand what they need to know in order to be able to help students in learning. However, this is possible only if the teachers possess a sufficient level of self-awareness for the metacognitive capabilities required to transfer professional development training into effective classroom practices (see Bransford, Brown & Cocking, 2000). According to the findings of Hughes' (2017) study, teacher education and professional development should focus on MA, because of its impact on common teacher practices. However, the scope, content and extent of pedagogic studies offered by different educational institutions may have substantial variance, resulting unavoidably in teachers having different starting points in MA. This dissertation examines how special and subject teachers in GE and subject teachers in VET support their learner MA in Finland. VET and GE subject teachers and special teachers are connected professionally by several factors: proficiency in the same subject between GE and VET subject teachers, and student age group and school context between special and subject teachers in GE. The education and job description of these teachers is described next.

Subject and special education teachers in general education

In grades 7–9 of general education (GE), which is often referred to as lower secondary education, subject teachers usually teach one main subject and from one to two subjects in accordance with their education. A subject teacher must possess a

master's degree in their field of education, combined with pedagogical studies, in order to be qualified. (Hammerness, Ahtiainen & Sahlberg, 2017). Subject teacher education also prepares teachers for upper secondary education and adult education duties. The mandatory pedagogical studies consist of basic studies in education and intermediate-level studies in the teachers' own subject areas (Hammerness et al., 2017), focusing on both theoretical and practical knowledge. Furthermore, the education provides didactic skills such as how to best teach learners and how to fulfill a teacher's legal and pedagogical responsibilities (Hammerness et al., 2017). Subject teachers are required a higher academic degree in their own subject, which includes 60 ECTS (European Credit Transfer and Accumulation System) of pedagogic studies. Special teachers are also required to have a higher academic degree which is typically completed in the training programme of special teachers in a faculty of education. A number of special teachers and subject teachers in GE have an elementary school teacher's education but have qualified to also act as a subject or special teacher by completing 60 ECTS as a minor subject.

Special education teachers are usually special needs teachers or special class teachers whose work usually includes development and planning duties. Coordination and cooperation with other teachers and school personnel, as well as with social service authorities is an important part of the work. In GE, special needs teachers and special class teachers teach grades 1–9. In Finland, special needs teachers follow the tripartite support system, divided into general, intensified and special support (Ahtiainen et al., 2012), working at each support level both in actual teaching and in multi-professional cooperation with various agents. A master's degree in an academic special education program must be completed in order to be allowed to take the admission test for special education teacher study program to become a qualified special education teacher. Teaching practice makes up an important part of special education teacher studies.

Teachers in upper secondary vocational education and training

The aim of vocational education and training (VET) is to improve the skills of the work force, to respond to the skills needs of the working world and to support lifelong learning (FNBE, 2015) and moreover, to provide students with the knowledge and skills needed in the development of their personalities and growth into balanced individuals and members of society. Students in VET can choose from more than a hundred professions in eight different education fields. Completing vocational studies also qualifies learners to apply to study in higher education. This makes the picture of VET teacher education highly multidimensional.

Finnish VET teacher education has gone through a massive reform during the past decades. In the 1990s there were 19 different units offering VET education

(Helakorpi 1995; see also Laukia, 2013). During this decade, the development of the University of Applied Science System meant a notable change in the field of education. At the same time, the Finnish Government decided to reduce the amount of vocational teacher education units and established five schools of vocational teacher education. The schools worked in conjunction with the Universities of Applied Sciences (UAS). These schools of VET teacher education provide pedagogical education for teachers working in vocational schools and for UAS-teachers.

Through reforms in the 80s, VET teacher education became more student-centered and its methods were made more connected to the workplace and community citizenship. Student-centered and peer-group methods are used in versatile learning environments and collaboration with other teachers and workplaces is emphasized. (Laukia, 2013; Isacsson, Amhag & Stigmar, 2018.)

VET teacher education programs' entrance requirements demand, with some exceptions, at least bachelor's or master's level education completed in the applicant's area of specialization, and at least 3-5 years of working experience. VET teacher education provides the pedagogical qualification for teaching specific subjects in a VET institute or UAS in Finland and takes from one year to one and a half years to complete. (Laukia, 2013; Isacsson et al., 2018.)

The aim of VET teacher education is to provide students with the knowledge and skills needed to guide the learning process of individual students, the competencies to advance in their own teaching area, taking the development of working life and different professions into account. The extent of VET teacher education is 60 ECTS. The degree includes basic studies in educational sciences, vocational pedagogy, and teaching practice, among other studies. (Ministry of Education and Culture, 2019.) The curriculum has changed from a subject-based to competence-based curriculum (Laukia, 2013; see also Isacsson et al., 2018). The teacher education program is a professional developmental program, but it is also a social process in which teacher-students develop their co-operative skills with other teachers, specialists such as student counselors, special needs teachers and the workplace (Isacsson et al., 2018).

VET teacher candidates in vocational teacher education should have an appropriate master's degree, an appropriate University of Applied Sciences (UAS) degree or the highest possible qualification in their occupational field, and at least three years of work experience in that field. Applicants are selected based on their previous studies and there is no specific entrance examination. The required qualifications for teachers in VET include education in their own vocational field, i.e. usually the one in which they work as teachers.

1.4 Issues of assessment in metacognitive awareness

In research on the assessment of an individual's MA, two main methods are used, on-line methods and off-line methods (Veenman et al., 2006). The pros and cons of both methods have been debated on (Veenman et al., 2006; Taber, 2013) revealing different results (Veenman, 2005). To study MA in this dissertation, rigorous evaluation of the methods was undertaken.

Teachers' thinking has long been a research focus in education. However, only little progress has been made due to difficulty in accessing the phenomenon (Duffy et al, 2009). There are several studies and inventories focused on learners' metacognition, but only a few take teacher MA into account, and even fewer studies examine both of these groups. Therefore, there is a relevant need for further study on teacher MA in general, but especially for research to create suitable methods to enable new research of the matter. New research on teacher education and training is needed to meet present demands of the curriculum regarding MA. Teacher educators, pre-service teachers and in-service teachers need to deepen their understanding of MA, because it is the basis of all learning and teaching.

Methodological approaches

On-line methods

On-line measurements are collected during the learning event through observations. The activities of the individual subject of the study are usually recorded during task performance (Sarac & Karakelle, 2017). This method is useful when a detailed description of teachers' classroom practices is needed **(**Van Beek, de Jong, Wubbels & Minnaert, 2014).**)**. However, the method's data collection and analysis are time-consuming, and it is therefore used in studies with a small sample size (Van Beek et al, 2014). A frequently used on-line measurement in assessing metacognition is the think-aloud method, also described as "talk aloud". As the name of the method implies, the person to be examined is instructed to express their thoughts as words while working on a specific cognitive task. The expressed thoughts are saved either auditorily or audio-visually, and transcribed and scored according to a coding scheme (e.g. Cromley & Azevedo, 2006; Thomas & Barksdale- Ladd, 2000).

Off-line methods

One way to investigate MA is by asking the subject of the participants to describe their perceptions. If the measurement is taken offline, that is, after the learning

session, the typical methods are questionnaires, stimulated recall protocols, interviews and diary entries. Studying perceptions off-line can be completed by asking the participants to fill in a self-report questionnaire and by collecting data with these inventories (see Helle, Laakkonen, Tuijula & Vermunt, 2013; Bandura, 1988b). There are several inventories that are used for that purpose of studying metacognition (e.g. Favieri, 2013; Biggs, 1987; Entwistle & Ramsden, 1983; Angelo & Cross, 1993; Weinstein, Zimmerman & Palmer, 1988; Pintrich, Smith, Garcia & McKeachie, 1993; Zimmerman & Martinez-Pons, 1986; Boulton-Lewis, Wilss & Mutch, 1996). It is to be noted that in these studies the character of the information was studied from the learner's point of view.

However, some self-reports have been developed for teachers as described before. Schraw and Dennison (1994) developed the Metacognitive Awareness Inventory (MAI) for students that was used as a basis for the MAIT (Balcikanli, 2011). Chan (2001) developed the Conception of Teaching and Learning Questionnaire (CTLQ) assessment inventory. However, according to Teo & Chai (2008, 216) who explored the Confirmatory Factor Analysis (CFA) of the questionnaire, the beliefs and ideas behind teaching and learning are often culture specific. The CTLQ was created to serve the developing of schools and teaching especially in Asian countries and is therefore weakly suitable for examining teaching culture in Western countries. The Teacher Metacognition Inventory (TMI), a six-factor structure scale developed by Jiang, Ma and Gao (2016), was validated during a teacher training program in China. In teacher studies, self-report questionnaires are also used to determine key aspects of variation in approaches to teaching. Trigwell and Prosser (2004), studied these aspects at the university level using the Approaches to Teaching Inventory (ATI). To collect data on interpersonal teacher behavior, the Questionnaire on Teacher Interaction (QTI) was used in a study by Wubbels, Brekelmans, and Hooymayers (1992).

The inventories mentioned above use paper and pencil to collect data, but recently, self-report questionnaires are more often filled digitally (e.g. Meirink, Meijer, Verloop & Bergen, 2009) by asking the participant to fill in a one-time form or to keep a digital log over a longer period of time. Examples of self-report questionnaires assessing metacognitive aspects along the objects of assessment are described in Table 1.

Table 1. Examples of self-report questionnaires assessing metacognitive aspects (see also Radloff & de la Harpe, 2001).

Objects of assessment	Questionnaire	Designed by
Cognition, metacognition, motivation and/or affect	Learning and Study Strategy Inventory (LASSI)	Weinstein, Zimmerman and Palmer (1988)
	Approaches to Study (ASI)	Entwistle and Ramsden (1983)
	Classroom Assessment Techniques (CATs)	Angelo and Cross (1993)
	Study Process Questionnaire (SPQ)	Biggs (1987)
	Motivated Strategies of Learning Questionnaire (MSLQ)	Pintrich, Smith, Garcia, and McKeachie (1993)
	Classroom Assessment Scoring System (CLASS)	Pianta, La Paro and Hamre (2008)
Cognition and metacognition	Self-Regulated Learning Interview Schedule (SRLIS)	Zimmerman and Martinez-Pons (1986)
	Learning statements	Boulton-Lewis, Wilss and Mutch (1996)
Self-efficacy and metacognition	Teachers' Sense of Self-Efficacy Scale (TSES	Woolfolk & Hoy (1990)
	Perceived Self Efficacy for Writing Scale (PSEWS)	Zimmerman and Bandura (1994)
Metacognition	Metacognitive Awareness Inventory (MAI)	Schraw and Dennison (1994)
	Junior MAI (Jr. MAI)	Sperling, Howard, Miller, and Murphy (2002)
	Metacognitive Awareness Inventory for Teachers (MAIT)	Balcikanli (2011)
	General Metacognitive Strategies Inventory (GMSI)	Favieri (2013)
	Metacognitive Strategies Integrals Inventory (MISI)	Favieri (2013)
	Teacher Metacognition Inventory (TMI)	Jiang, Ma and Gao (2016)

The stimulated recall method is a favored offline methodological approach similar to the online think-aloud method. In stimulated recall, the participant is asked to view a recorded video of the lesson together with the researcher and is then interviewed. (Taber, 2013: 279-280). The viewing acts as a stimulus to help recall the thinking that has taken place during the teaching (Duffy et al., 2009).

The interaction between the researcher and the participants as well as the relationship between output and noticing has been widely argued by many researchers (Imafuku, Saiki, Kawakami & Suzuki, 2015; Suzuki & DeKeyser, 2015).

In the next chapter, the advantages and disadvantages of the methods used in assessing MA are discussed in light of their challenges.

Methodological challenges in assessing metacognitive awareness

Despite the distinguished effort to study teacher MA, there are still challenges associated with the research on teachers as metacognitive professionals. According to Duffy et al. (2009), the problems have to do with the terminology used to describe teacher thought and the fact that metacognitive action is situational. Furthermore, there are only few methodological tools for studying the essentially invisible act of teacher thinking.

In the field of metacognition, one of the most common discussions of the challenges of the research is how to develop and use valid tools to assess the phenomena (see Veenman, 2015, Dinsmore & Alexander, 2012; Panaoura & Philippou, 2003). According to Sperling et al. (2002), self-report inventories are possibly the least problematic technique in measuring metacognitive processing. They have many benefits, particularly in large-scale assessment of metacognition. Self-report inventories have also proved to be useful in theoretical studies of metacognition. Components of metacognition can be measured via self-report inventories (Sperling et al., 2002; Pereira-Laird & Deane, 1997; Schraw & Dennison, 1994).

The validity of self-report questionnaires has been criticized by some scholars for not assessing metacognition and self-regulation widely enough (Schellings, van Hout-Wolters, Veenman, & Meijer, 2013). Self-report questionnaires are regarded to point out the readiness, but not necessarily the ability of MA (see Virta, 2005). According to Kuhn (1989) it may be difficult to engage in scientific reasoning if one does not understand the theory behind it. The subjective viewpoint of perception can also be problematic in assessing metacognitive or cognitive aspects. However, it is necessary to note that the criticism of self-reports is more often especially targeted at the use of enquiries with children (see Winne and Jamieson-Noel, 2002; Veenman, 2011).

A conclusion can be drawn that knowing the limitations of the self-reporting method is crucial. However, the method also has strong pros and many useful aspects in studying individuals' MA, especially in larger groups. Due to being easily administered and scored and thus useful for large-scale assessment of determining the need for metacognitive intervention, the self-report method is evidently the least problematic method in assessing MA (Sperling et al., 2002). Self-report inventories can also be greatly helpful in theoretical research of MA. From the point of view of this dissertation, research confirming that both the knowledge and regulation

components of metacognition can be measured via self-report inventories is very important (see Pereira-Laird & Deane, 1997; Schraw & Dennison, 1994; Panaoura & Philippou, 2003).

Finally, after these considerations, the self-report questionnaire was chosen as the most suitable method to assess MA in this dissertation because of the large number of participants. This dissertation also considers the MAIT (Balcikanli, 2011) and the MAI (Schraw & Denisson, 1994) to be valid and reliable instruments in measuring MA. The MAIT was chosen as the most suitable assessment tool for studying teacher MA in **Study I**, because it is considered to help teachers realize their metacognitive levels of teaching (Balcikanli, 2011, p. 1320). To study the components of MA and to investigate learner MA, the MAI (Schraw & Denisson, 1994) was selected for **Study II**. Based on these studies, a new assessment tool to study teachers' support for learner MA was developed for **Study III**.

2 Aims and structure of the study

The main aims of the study are to deepen the existing understanding of teacher MA and to study how teachers across different domains of teaching support their learners' MA. The specific aims are extending the concept of MA by examining how perceived MA can be categorized, especially from the point of view of teachers' support, and finally, to develop methods to capture and analyze teachers' support for learner MA. Therefore, the aims of this dissertation are methodological, theoretical and empirical in nature.

Three empirical studies were carried out to address these aims. In **Study I**, the methodological aim was to validate the instrument of assessment of teacher MA for national use. In **Study II**, the validation of the instrument of assessment of learner MA was carried out similarly for national use, with the theoretical aim of exploring the structure of the components of MA. Furthermore, the empirical aim was to examine the extent to which students' self-evaluation could be predicted by the components of MA. The methodological aim of **Study III** was to develop an instrument to study teachers' support for learner MA, with a theoretical aim to examine the concept of Support for MA. Finally, teachers' perceived support for learner MA across different domains was empirically explored with the newly developed instrument.

Even though the sub-studies are presented consecutively in the following paragraph, parts of the procedures and general aims of the studies overlap. For the sake of clarity of the structure of the dissertation in its entirety, the sub-studies are presented and described separately from each other in Table 2 as follows:

Table 2. The aims and research questions for each sub-study.

Sub-studies	Specific aims	General aims	Research questions	Participants
Study I	Examining the validity of the MAIT-18	methodological empirical	What is the validity of *the MAIT-18 among in-service teachers?	teachers (N=208)
Study II	Examining the extent to which students' self-evaluation could be predicted by the components of knowledge and regulation of cognition in MA.	methodological theoretical empirical	1. How does knowledge of cognition predict self-evaluation? 2. How does regulation of cognition predict self-evaluation?	students (N=578)
Study III	Exploring perceived support for learner MA across different domains of teaching in relation to three main components: knowledge of learning objects, regulation of learning strategies and self-evaluation.	methodological theoretical empirical	1. To what extent do subject teachers in VET and GE and special teachers differ in how they support learner MA? 2. To what extent do subject teachers in VET and GE differ in how they support learner MA a) in GE subject groups and b) in VET subject groups? 3. How do the following background variables reveal group differences in support for learner MA? a) In-service teaching experience b) Gender c) Qualifications	teachers (N=1045)

* the compressed version of the Metacognitive Awareness Inventory for Teachers (MAIT-18)

Since MA is culturally bound and because different educational environments result in differences in metacognition (Angelova, 2001; Hacker & Bol, 2004), the empiric data collection instruments had to be validated into use among the participants. Therefore, the questionnaires MAIT, developed by Balcikanli (2011) and MAI, developed by Schraw and Dennison (1994), were validated among Finnish teachers and learners for **Studies I and II**. After validating the instruments, the components and the structure of MA were explored among teachers (**Study I**) and learners (**Study II**). In **Study II**, the aim was to examine the extent to which students' self-evaluation could be predicted by the components of knowledge and regulation of cognition in MA. This information was highly important for studying the support for learner MA in later studies. The sub-studies are hence intertwined, each forming the background

and base for the next study. Finally, based on the results of **Studies I and II**, teachers' support for learner MA was investigated using the Inventory of Teacher's Metacognition Support (ITEMS) in **Study III**. The concept of support for MA was also examined theoretically in the study. The empirical aim of **Study III** was to find out the extent to which subject teachers in VET and GE and special teachers differ in how they support learner MA, as well as the extent to which support for learner MA differs between the respective subject groups taught by subject teachers in VET and GE. Furthermore, the aim of **Study III** was to explore how certain background variables reveal teacher group differences in supporting learner MA.

3 Methods

This chapter describes the participants, measures and procedures of the analyses of the study, and how the validity and reliability of the research was assessed during the process. A summary of the data collection and statistical analyses with respect to the original empirical studies and their main aims are presented in Table 3. In each of the studies, SPSS was used to conduct the statistical analyses, and the MPlus software was used for structural equation modelling. The main statistical analyses of the dissertation are briefly described and summarised in Table 4 later in this chapter.

Table 3. Summary of methods.

Sub-studies	Participants	Materials and data collection methods	Analyses
Study I	teachers (N = 208) from three training consortiums providing vocational education	A compressed version of the Metacognitive Awareness Inventory for Teachers (MAIT-18)	- Correlation analysis and Cronbach's alpha - The number of items was compressed in certain factors - Confirmatory factor analysis (CFA)
Study II	students (N=578), from ten units of vocational education institutions	Metacognitive Awareness Inventory (MAI)	- Correlation analysis and Cronbach's alpha - The number of items was compressed in certain factors - Structural equation modelling (SEM): a) Confirmatory factor analysis (CFA) b) Path modelling
Study III	teachers (N=1045): upper secondary VET teachers and GE subject teachers and special teachers in Finland	A new assessment tool, ITEMS, was developed for Study III	- Correlation analysis and Cronbach's alpha - Analysis of variances - Confirmatory Factor Analysis (CFA)

3.1 Participants and data

Participants of Study I were teachers (N = 208) from three training consortiums providing vocational education. The training consortiums were made up of 13 units, with a combined total of approximately 450 teachers. The in-service experiences of the participants varied. Both novices and well-experienced teachers were present in the data (in-service experience: mean = 14.8, median = 13 years). Forty-seven percent of the participants were men (n = 98) and fifty-three percent were women (n = 110). The participants of the study were teachers from different domains of vocational education and training (VET), such as business and economics, social and health, tourism and catering, transport and logistics, automotive, electronics, culture, education, construction, beauty treatment, ICT, engineering and metal industry, seafaring, audiovisual communication, and the visual arts. The data was collected under agreement with the boards of the participating training consortiums. Participants of Study II were students (N = 578) from ten units of vocational education institutions in Southern and Western Finland. Forty-one percent of the participants were men and fifty-nine percent were women. Seventy-three percent of the participants were 15 to 18 years old, while twenty-seven percent were 19 years or older. The participants of the study represented the same sectors of VET as the participants of Study I. In Study III, the participants (N = 1.045) were secondary VET subject teachers, general education (GE) subject teachers and special teachers in Finland. The study uses the data from nationwide Learning To Learn assessment in the lower secondary level of general education gathered by the Centre of Educational Assessment in University of Helsinki. The data of VET teachers was gathered from 12 units of three major VET institutes for the research project of this doctoral thesis. The survey of GE was conducted in 83 schools and the data included both GE subject teachers and special teachers. The participants represented three major VET subject groups and seven GE subject groups. The subject groups in VET were technical subjects like automation, ICT, electronics, services, social and health care subjects, and subjects of humanities, culture and education.

All the teacher participants were in-service, teaching in two different educational environments, representing domains in VET and GE. In Study II, the participants consisted of students from VET. The research produced new comparative evidence since the teacher groups of the studies in this dissertation had different educational backgrounds. Teachers of different subjects work in different types of education, and special education teachers, who work with learners who need general, intensified or special support in learning, also have a distinct work environment.

The data for this dissertation has been collected in Finland for several reasons. First, the Finnish educational system has a clear and uncomplicated organisational and administrative structure. Second, Finland has consistently ranked as one of the top countries in Programme of International Student Assessment (PISA) survey

(OECD, 2019). Moreover, both VET and GE have recently gone through reforms in Finland. The core curriculum for GE was remodelled in 2014 and implemented in 2018 and vocational education and training went through major reforms in 2018. Both in GE and VET, the application of modern teaching methods and learning styles is placing more responsibility on students, steering them towards 'learning-to-learn' and 'self-directed studying' trends. For teachers, this means a more supportive role while students are required to learn self-regulation skills. The data concerning the present study was gathered just before the reforms came into effect. There is great potential for a new data gathering after the transitions.

Discussion on collaboration and ethical issues

This research was conducted as part of an international co-operation project between University of Helsinki (UH) and University of Turku (UT) in Finland and University of Southeast Norway (USN). The project started in Finland in 2014, in response to the new curricular focus on "learning how to learn" improvement, aiming to study the MA of teachers and their learners' preparedness to self-regulate their learning. The need to gain knowledge on the evaluation of "learning to learn" has become accentuated as metacognition has been highlighted as one of the most important elements of reformed curricula in countries like Finland and Norway. There is much interest in collaboration between these countries because of their current educational policies leaning in the same direction. In Norway, general reforms are also underway, as the Core Curriculum for compulsory education is being reorganised according to Ludvigsen's (NOU, 2015) Official Norwegian Report to the Ministry of Education, which highlights metacognitive regulation of learning as a central skill for schools to teach in the future. VET in Finland is also being reformed, with the Ministry of Culture and Education reconsidering authorisation given to educational institutes to provide education. With simultaneously reduced funding, this will mean less traditional contact teaching and more responsibility on students while applying modern teaching methods and learning styles.

Furthermore, the cooperative research project has been implemented with the Centre for Educational Assessment (CEA) at University of Helsinki (UH). The validated MAI and the newly developed ITEMS (both instruments as a compressed version) were used in a large (teachers N=1045 and students N= 7 811) national study of learning to learn in Spring 2017 (Kallio, Virta, Kallio, Hotulainen, Lampi, Tamm & Ahtiainen, 2019). The project demonstrates the need for assessment instruments such as the MAI and ITEMS.

These cooperating parties have had a supporting role and an inspiring effect from the point of view of this thesis. However, this thesis deals with only the Finnish data of the international co-operation project and hence, is an independent research work

for which the author of this thesis is responsible as follows. The author of this thesis holds the main responsibility in all three sub-studies and bears the full responsibility for the summary of the thesis. The author of this thesis participated closely and had a significant role in designing, pre-evaluating, modifying and validating the questionnaires used in each of the Studies and therefore shared responsibility for the decisions that were made in the whole process of developing the sub-studies from phase to phase. The author of this thesis also gathered the data for Studies I and II. The data gathering for Study III was performed by the Centre for Educational Assessment (CEA) at University of Helsinki (UH). Furthermore, the author of this thesis participated actively in analyzing the results. All members of the research group of each sub-study of this thesis have been presented as authors in the order that has been jointly agreed upon in good scientific spirit, meeting all criteria for authorship, including approval of the final manuscripts. All members have full confidence in the accuracy and integrity of the work of the other group authors.

Strict ethical codes for scientific research and practices of study design, conduct and report, as well as data handling, security and protection of participant anonymity have been followed throughout each of the three studies according to the guidelines of the Academy of Finland (2019), Finnish Advisory Board on Research Integrity (2019) and University of Turku. Therefore, the characteristics of good scientific practice of this study have been carried out. The leadership of the participating institutions, participating students and teachers were informed of the nature of the project, the data to be collected and assured of the anonymity of the stored data. Furthermore, they were informed that participation was strictly voluntary. The master copies have been saved in a separate database. Ethical and legal compliances have been planned with the help of University of Turku's template "Tuuli DMP".

The data gathering sessions were held in groups. The principals of the sampled schools and institutions were informed of the study and asked for permission to hold the survey beforehand. The purpose of the study and of the use of the data was explained to the participants in the beginning of each session. The participants were also told how the data was to be encoded to protect their anonymity. Finally, short instructions on how to fill in the questionnaires using pen and paper were given. All researchers and teachers involved in gathering or handling the data agreed on data handling and participant confidentiality norms. No personal identification information was gathered from the participants. The group codes used in analysis and the names of the participating institutions were stored separately from the main data.

Other researchers' work and achievements have been referred to in an appropriate way according to good scientific practice. The sources of funding and other associations relevant for the study were notified to collaborating parties of the

study, and were reported in the published original articles included in this dissertation, as well as in the summary of the study.

3.2 Measures and statistical analyses

Self-report instruments were chosen to evaluate MA, because they allow data to be collected based on the teachers' and learners' own understanding, as well as data across teacher professions for comparative studies. Berger and Karabenick (2016) underline the opportunities and practical advantages of self-report instruments in large-scale testing. Survey data were gathered by using three different self-report instruments, described in this chapter.

The Metacognitive Awareness Inventory for Adults (MAI) (Schraw & Denisson, 1994) and The Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011) were chosen as the most suitable instruments of data collection. This was due to their focus on MA that is based on a theoretical background. It is strongly believed that knowing what teachers know of their teaching should become a focal point of teacher development. It was shown by MAI that knowledge of cognition and regulation of cognition were highly intercorrelated. (Schraw & Dennisson, 1994; Harrison & Vallin, 2017). With the MAIT, teacher MA will be measured in main components of knowledge of cognition (metacognitive knowledge) and regulation of cognition (metacognitive regulation). Both components consist of subcomponents: knowledge of cognition consists of declarative knowledge, procedural knowledge and conditional knowledge and regulation of cognition consists of activities such as planning, monitoring and evaluating. The selected and designed instruments are used at this education level (VET) for the first time. In addition, Finnish education culture, like all cultures, has its own distinctive features. Therefore, the validation of the instruments is crucial.

The MAIT-18 was validated to examine teacher MA in Study I. The original 24-item MAIT (Balcikanli, 2011) is derived from the MAI (Schraw and Denisson, 1994). The MAIT is a resource that helps teachers realize their metacognitive levels of teaching (Balcikanli, 2011, p.1320). With the inventory, MA can be studied in two main components, similarly as with the MAI, based on the Brown (1987) model of metacognition: knowledge of cognition and regulation of cognition. In the study of Balcikanli (2011), the questionnaire was modified to a 5-point Likert scale with a range from 1 to 5 ("strongly disagree - strongly agree"). The inventory denoted high alpha and confirmed the theoretical existence of eight subcomponents of MA. However, the final factor structure was based on only six factors with four items each. During the procedure of analyses, one item from each factor was removed to compress the measurement into the 18-item version.

The MAI, developed by Schraw and Denisson (1994), was chosen to study learner MA in Study II. It is a 52-item self-report questionnaire that has been used to confirm the theoretical existence of two components of MA, knowledge of cognition and regulation of cognition, which are quite close to each other. The final factor structure was best represented by dividing the factors into eight subcomponents: conditional knowledge, declarative knowledge, procedural knowledge, planning, monitoring, information management strategies, debugging strategies, and evaluation of learning, respectively. This structure was also confirmed by the results of Sperling et al.'s study (2004). In Study II, the concept of evaluation refers to self-evaluation in particular, which concerns the learner's own objectives and is directed at a general level of learning. Therefore, this specific concept was used in the study to avoid any misunderstanding that may have stemmed from the use of the term 'evaluation' from the original MAI questionnaire.

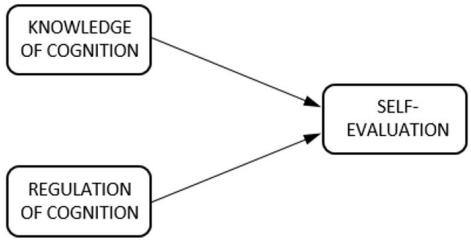

Figure 2. Self-evaluation as the reference component for both knowledge and regulation of cognition.

According to the model used in this study, both the knowledge of cognition and the regulation of cognition predict self-evaluation (see Figure 2). In earlier studies of MA, self-evaluation has been included to the regulation of learning (Jacobs & Paris 1987; Schraw & Dennison 1994¸ Balcikanli, 2011). In the present study, the component of self-evaluation is examined separately as an independent factor. Self-evaluation is therefore studied under the assumption of being divided into separate components, depending on what the student evaluates in one's own learning. Hence, instead of treating self-evaluation as a general phenomenon or skill, it should be examined in levels following the knowledge of cognition theory: 1. how do I learn (procedural knowledge, or a strategic understanding of one's own learning), 2. what do I learn (declarative knowledge, or an understanding of the content of learning) and 3. for what do I learn (conditional knowledge, or the person-specific knowledge of learning that is connected to the intrinsic motivation of the student).

Therefore, in this dissertation, self-evaluation is studied as the link to both the knowledge part of learning (knowledge of cognition) and to the activity and skill parts of learning (regulation of cognition) of MA, which are regarded as the two main

components of MA in earlier studies. This new model of MA contains three main components instead of two: knowledge of cognition, regulation of cognition and self-evaluation. The examination of self-evaluation as a main component of MA will make the holistic study of MA more sensible. Presenting MA in this model of three main components improves examination and evaluation in comparison with the two-component model.

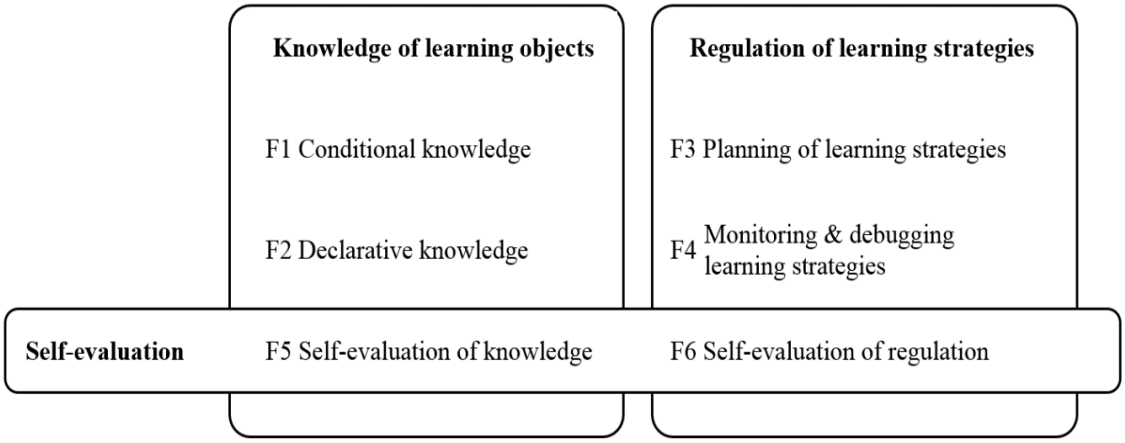

Figure 3. Structure of the components of ITEMS-18.

To assess teachers' support for learner MA in the Study III, the *Inventory of Teacher's Metacognition Support (ITEMS-18)* was used. The inventory consists of six factors with three items each, adding to 18 items altogether. The ITEMS-18 inventory is a compressed version of ITEMS-24, which consists of eight factors with three items each. The validated scales of MAIT-18 and the original MAIT (Balcikanli, 2011) employ a similar theoretical structure but consist of only two main components, whereas the new theoretical model of MA used in Study III consists of three: *self-evaluation, knowledge of learning objects and regulation of learning strategies* (Figure 3). This new model is based on the confirmed model of MA in Study II, in which self-evaluation serves as a reference component for both knowledge and regulation of cognition (see Figure 2). All three main components were measured using two sub-components of three items each (see Figure 3).

Stimulating a learner's understanding as one of the most important guiding activities plays an essential role in supportive teaching strategies (De Bruijn & Leeman, 2011). To foster the learner's conditional knowledge (F1), the teacher stimulates an understanding of learning objects and supports the learner in setting one's own learning objectives. To enhance the learner's declarative knowledge (F2), the teacher stimulates an understanding of the task and its subject content and

supports the learner in setting objectives concerning 'what to learn' and 'what should I learn?' on the basis of 'what do I already know/don't know.' Diverging from the model of MA by Schraw and Dennisson (1994), the sub-component of procedural knowledge was omitted from the knowledge component as it refers more to a person's procedural knowledge for regulating one's problem-solving and learning activities (Brown & DeLoache, 1978; Veenman, 2005; Veenman et al., 2006).

Fostering learners' regulation of learning strategies requires teacher support in stimulating learners' understanding and determination of their own learning strategies. This happens through planning (F3), monitoring and debugging (F4) learning strategies through articulating and discussing problem-solving strategies (see De Bruijn and Leeman, 2011.) Therefore, the sub-component F4 combines three original sub-components of regulation from ITEMS-24 (monitoring, testing and debugging), taking one item from each. Combining these three sub-components was possible due to their theoretical similarity within the same main component. One item from each original sub-component was selected, by considering which item best represents its original sub-component while forming a theoretically coherent combination with the items from the other sub-components.

Focusing on both original main components, knowledge and regulation of cognition, two sub-components of self-evaluation are formed, i.e. self-evaluation of knowledge (F5) and self-evaluation of regulation (F6). This theoretical distinction is in line with Desoete, Roeyers, Buysse, and De Clercq's (2002) view that metacognitive knowledge and skills cluster together and that conditional knowledge chiefly comprises of predicting and evaluating. In self-evaluation of knowledge, the teacher helps the learner evaluate their own learning objects by posing questions about declarative knowledge (How well did I manage? What did I learn?) and conditional knowledge (Which aims did I achieve?). In self-evaluation of regulation, the teacher helps the learner to evaluate their own learning strategies.

Pretesting the measurements has been carried out in each of the sub-studies. The original MAI and MAIT questionnaires were translated into Finnish and back into English by an experienced translator to ensure the translatability of concepts and phrases. Final versions were decided based on modification suggestions given by translators and a Finnish mother tongue lecturer. The questionnaires were pre-tested and validated through a three-step procedure. In the first step, three native Finnish speaking researchers each made their own version of the items in the inventory and then the versions were combined and checked by a Finnish mother tongue lecturer. In the second step, the new Finnish questionnaire was translated back into English by an experienced translator to ensure that the concepts and phrases are translatable in both languages. The final versions of the MAIT and ITEMS questionnaires were composed taking into account modification suggestions made by the translator and the native Finnish-speaking lecturer. The third step of the procedure was to test the

questionnaires using a group of teachers (n = 8) in a VET institute. The teachers were presented with a research project similar to that used for main data collection later on. The pilot group was asked to pay special attention to possible unfamiliar concepts or unclear statements. When using a questionnaire as a self-report instrument, the implications or interpretations of the subject must be carefully considered (Hopfenbeck, 2009, p. 17). The teachers were asked to present their questions or notes instantly or write them on the questionnaire form. As the MAI inventory was originally intended to study MA in learners, a pilot group of students was also used to pre-test the measurements for the Study II. As in the teacher pilot group, students (n = 28) from a VET institute were asked to rate each item on a Likert response scale after being presented with a research project similar to that used for main data collection later on. The student pilot group was also asked to pay special attention to possible unfamiliar concepts or unclear statements, and to present their questions or notes instantly or to write them on the questionnaire form.

Validity and reliability considerations

Since MA is culture bound and different educational environments can result in differences in metacognition (Angelova, 2001; Hacker & Bol, 2004), the instruments of empiric data collection had to be validated for use among the examined participants. Exploring the validity of measurements concerns their utility as well. However, validation is not an easily defined concept as reviewers have different definitions for it (e.g., Goldstein, 2015; McGrath, 2005; Barret, 1992). The processes of validation should meet with certain factors (Geisinger, 2016, p. 287). Results following the measuring should be duly used for certain purposes and be reasonably interpreted. Since the concept of validation is complex, Geisinger recommends using the term utility instead. Therefore, utility is used in Study I alongside the concept of validity.

It is possible that the students' accounts of the extent of the teachers' incorporation of metacognition differ from the teachers' (see Van Beek et al., 2014). The validity of self-reports has also already been considered several times in this study. However, the opportunities and practical advantages of self-report instruments in large-scale testing have been underlined (Berger and Karabenick, 2016). Every method has its own advantages and drawbacks, but further examination is needed to develop more exact measures. This dissertation takes the position that research is best served by improving the reliability and validity of research tools and measures.

When a measure is used as an index of a variable that is not itself directly observable, such as MA in this dissertation, construct validity is examined to determine how well a certain test measures what it is supposed to measure (Westen

& Rosenthal, 2003). Construct validation is always theory dependent (Cronbach & Meehl, 1955). Reports on the validity of the measurement describe the extent to which the measurement's perceived associations with the measurements of other variables correspond with a theoretical prognosis of the association.

Confirmatory Factor Analysis (CFA) was used to test and measure the fit of the factor structure of the questionnaires used in each of the three studies. The relations between the factors were analysed using path modelling in Study II. Both CFA and path modelling are solutions of Structural Equation Modelling. In complete, so called hybrid SEM, the fit of the factor structures of the measurement models and the paths between them, i.e. latent variables, are analysed simultaneously. Using Structural Equation Modelling (SEM) is likely to reduce the effect of measurement errors of the observed variable common to traditional regression analysis or path analysis (Kline, 2011; MacCallum & Austin, 2000.) However, to explore the fit of the measurement models and the path model separately in more detail, they are practical to implement separately (McDonald & Ho, 2002). Hence, the sum variables from the latent variables are calculated to form a so-called path model of the manifest variables in Study II.

The validity of the MAI, used in Study II, has been reported on several earlier studies (e.g. Sperling et al.,2004, Young & Fry, 2008, Zhang, 2010), described earlier in Chapter 1.2. Findings of these studies indicate that overall, the MAI produces structurally valid and internally congruent results. Furthermore, structurally valid and internally congruent results have also been produced according to the division of the two main components. Some research reports (e.g., Pintrich, Wolters, & Baxter, 2000) indicate, however, that these components are quite close to each other.

In all three studies, the internal consistencies of the components and the entire questionnaires were estimated by calculating Cronbach's alpha (Cronbach, 1951). The MAI has been denoted to have high internal consistency of the factors of knowledge of cognition and regulation of cognition (Akin, Abaci, & Çetin, 2007). Internal consistency statistics range between r = .90-.95 (Dennison, 1997). It has firm predictive validity for self-monitoring and test performance in academic processes. Subsequent studies with the MAI have supported these findings (Hammann, 2005). It is therefore considered a reliable initial test of MA (Schraw & Dennison, 1994, p. 472; Scott & Levy, 2013).

Analyses of descriptive statistics, correlation and variance

The main statistical analyses of the dissertation are briefly described as follows (Table 4).

Table 4. Summary of statistical analyses used in the sub-studies.

Statistical Analysis	Study	Purpose
Descriptive statistics	I, II, III	- to give a more detailed description of the data - to ensure that the matrix was suitable for the analysis using parametric methods (frequencies, mean, skewness, kurtosis and standard deviation were analysed) - to formulate comparable groups of respondents meaningfully
Correlation analysis (Pearson's correlation)	I, II, III	- to explore how the questionnaires could be compressed
Cronbach's alpha	I, II, III	- to explore the internal consistency of the scale and the sub-scales to conclude the reliability
Analysis of variance - One-way ANOVA, Tukey's HSD - Student's T-test	III	- to analyse the statistical significance of the variances
Structural equation modelling (SEM): - Confirmatory Factor Analysis (CFA) - Path modelling	I, II, III II	- to explore how the questionnaires could be compressed - to analyse the fit of the factor structure of the questionnaires - to test the theoretical path model of the components

The statistical analyses in each three studies consisted of two general phases. At first, descriptive statistics were calculated to ensure that the data matrix was suitable for the forthcoming parametric analyses. Secondly, the factor structure was examined and compressed using confirmatory factor analysis and correlation analyses. After these procedures, further analysis took place, i.e. analyses of variance in Study III and path modelling in Study II.

In the first phase in each three studies the parameters of the data matrixes were examined with descriptive statistics. Comparable groups of respondents were formulated for meaningful analyses. Also, the normality of the data was verified at this phase.

Analysis of the factor structures took place in each three studies. Preliminary examination was made using correlation matrixes to ensure that the items in each factor correlate with each other meaningfully. Confirmatory factor analysis was used to deepen the understanding of the interrelations of items and factors. Interpretation of several fit and modification indexes with correlations was made to select items

for removal to compress the questionnaires. Finally, the internal consistency of the scales and sub-scales were analysed by calculating Cronbach's alpha.

After the preliminary methodological procedures, the analyses of variances took place in Study III. One-way ANOVA with Tukey's HSD post hoc was used to compare the groups of respondents. Also, Student's T-test was used with dichotomous background variables such as gender. In Study II, path models were examined to verify how well the theoretical relations are observable in the empirical data.

4 Overview of the empirical studies

This dissertation contains three empirical studies with the aim of deepening the understanding of perceived MA among teachers and learners, and extending the concept of MA. **Study I** examines the validity of the instrument used to measure teacher MA to explore how teachers' perceived MA can be categorized. **Study II** explores the structure of learner MA. Results from Studies I and II were combined to form the background for **Study III**, which investigates different teachers' support for learner MA.

4.1 Study I

Kallio, H., Virta, K., Kallio, M., Virta, A., Hjardemaal, F.R. & Sandven, J. (2017) The Utility of the Metacognitive Awareness Inventory for Teachers among In-service Teachers. ***Journal of Education and Learning; 6*****(4), 78-91. <https://doi.org/10.5539/jel.v6n4p78>**

The aim of Study I was to examine the utility of the Metacognitive Awareness Inventory for Teachers (MAIT) (Balcikanli, 2011) among in-service teachers. Previous educational studies have tended to focus on pre-service teachers, meaning that the MA of in-service teachers has only been studied to a limited extent. The data was collected from in-service teachers (N = 208) from three training consortiums of vocational education. Both novices and well-experienced teachers were represented in the data (in-service experience in years: mean = 14.8, median = 13). The reliability and validity of the inventory was examined to find out the utility of the measure. Moreover, the utility of the inventory was improved by compressing the original 24-item version into an 18-item version (MAIT-18).

The data was analysed in two steps. First, the inventory's internal consistency and fit of factor structure were examined. The consistency of the factor structure was explored calculating Pearson's correlation between the items in each factor. The factor structure of the questionnaire was measured and tested using Confirmatory Factor Analysis (CFA). One item from each factor was removed to compress the questionnaire into an 18-item version. The internal consistency of the compressed MAIT-18 questionnaire was estimated by calculating Cronbach's alpha. The

instrument was designed to confirm the theoretical existence of the two-component model of metacognition (Brown, 1987; Schraw & Dennisson, 1994), knowledge of cognition and regulation of cognition.

The internal consistency of the questionnaire and its components was found to be acceptable /good or even excellent in training consortiums. The internal consistency of the regulation of cognition was found to be better than of the knowledge of cognition. The analysis revealed that the data was suitable for the second step: exploring the factor structure of the MAIT-18 using the CFA. Both main components were comprised of three subcomponents: declarative, procedural, and conditional knowledge in knowledge of cognition and planning, monitoring, and evaluation in regulation of cognition. No cross-loadings were added into the model, but it should be acknowledged that the components are quite close to each other. The result of the final CFA of the MAIT-18 revealed a good/acceptable fit of the factor structure.

According to these findings the MAIT-18 is suitable to be used in comparable studies to analyse large sample groups from different cultures of learning and teaching in measuring the MA of teachers. The results revealed that the original MAIT-24 had some weaknesses. It was therefore important to adjust the items of the instrument by compressing the questionnaire, improving the fit of the factor structure to good/acceptable. The results of further studies applying MAIT-18 can be used to develop teaching and learning culture in teacher training. MA is a key concept for teachers to reflect on their own work and the learning support they give to their students. Since the study of teacher MA in educational research is minor, it is highly important to gain more detailed empirical research in the field. The methodological progress and the considerations of the first study formed the basis on which to continue to Studies II and III.

4.2 Study II

Kallio, H., Virta, K. & Kallio, M. (2018) Modelling the Components of Metacognitive Awareness. *International Journal of Educational Psychology*, *7*(2), 94-122. <https://doi.org/10.17583/ijep.2018.2789>

The purpose of Study II was to explore the components of MA. The earlier models delineating MA are divided into two main components: knowledge of cognition and regulation of cognition. In these models, self-evaluation has been designated as a subcomponent of regulation of cognition (Brown, 1987; Schraw & Dennisson, 1994). Study II presents an empirically tested new theoretical model, in which self-evaluation acts as a link between the knowledge of cognition and the regulation of cognition and hence acts as a reference component between these main components of MA (see Figure 2).

Previously, self-evaluation has been described as a sub-component of regulation of cognition (e.g., Vermetten et al., 1999). However, the hypothesis of this study is that both knowledge of cognition and regulation of cognition predict self-evaluation. According to this, self-evaluation is not a component of regulation as such, as it does not regulate the ongoing or forthcoming process of regulation but is rather a tool used to reflect both knowledge and regulation. The research task was to examine the extent to which self-evaluation can be predicted by the knowledge of cognition and regulation of cognition components. The subcomponents of knowledge of cognition (conditional, declarative and procedural knowledge) and self-evaluation were examined in a conjoined model. Similarly, the sub-components of regulation of cognition (planning, monitoring, information management strategies, and debugging strategies) and self-evaluation were examined in another conjoined model. The path modellings confirmed that self-evaluation refers to both knowledge of cognition and to regulation of cognition (see Figure 4).

To address the aim of the study, this theoretical model was empirically studied using the Metacognitive Awareness Inventory (MAI) (Schraw & Dennisson, 1994), among vocational education and training (VET) students (N= 578) from ten VET institutions in Finland. The main aims of VET in Finland are to improve the skills of the work force, to respond to skills needs of the working world and to support lifelong learning. The study was conducted in Finland, because "learning to learn" has been emphasized in curriculums at all levels of the Finnish educational system for decades. The field of VET presents a highly actual platform for research on student MA, as educational reforms have led to a teaching culture with fewer lessons, less contact teaching and more responsibility placed on students to regulate their own learning. For teachers, this means taking a more supportive role, which requires knowledge of cognition, regulation of cognition, and self-evaluation from the students themselves. Furthermore, MA is required in knowledge-intensive work and lifelong learning. Although metacognition itself and self-regulation of learning have been highlighted in educational research and educational policies, the role of MA in VET has been studied less.

The MAI is a 52-item self-report instrument of adolescent and adult MA based on the theoretical structure of two main components of MA, the knowledge of cognition and the regulation of cognition. The factor structure was best represented by dividing the two factors into eight subcomponents: conditional knowledge, declarative knowledge, procedural knowledge, planning, monitoring, information management strategies, debugging strategies, and evaluation of learning, respectively. This structure was also confirmed by the results of Sperling et al. (2004). The analysis was done in two steps. At first, the factors were composed following the theoretical structure of the items. Moreover, the structure of the factors was confirmed with CFA and their reliability was analyzed by calculating

Cronbach's alpha. Second, the theoretical path model of the components was tested using Mplus Structural Equation Modelling (SEM) software.

The results revealed that students' MA can be measured using the MAI and modeled following the theoretical framework. In the study, it was confirmed that self-evaluation acts as a reference component between knowledge and regulation of cognition. Both models (the path of knowledge of cognition and the path of regulation of cognition) fit the data. The main findings and conclusions were:

1. Conditional knowledge is the first and the most effective predictor for self-evaluation, while declarative knowledge and procedural knowledge are minor predictors.
2. Planning predicts the other components of regulation.
3. Knowledge of cognition and regulation of cognition can refer to each other using self-evaluation as a reference component (see Figure 2).

These SEM results conclude that the conditions and goals appointed by the learner predict their selection of contents and strategies towards the self-evaluation of their own learning. In other words, by measuring planning or conditional knowledge we could predict other components of knowledge or regulation of cognition and, especially, of self-evaluation. The findings of this study extensively confirm that planning and knowledge of condition predict success through the learning process. The composed models fit in both genders and ages. However, the fit of the models is not as suitable among young men as among other observed groups. This is an issue for further studies and should be explored deeply.

The findings of this study show that the VET students' knowledge and regulation of cognition follow the theoretical assumptions of MA. These results encourage towards even more learner-centered culture, in which the students are expected to set goals for their own learning, supported by their teachers. The results also encourage teachers to support their students in improving their MA and to expect them to set goals for their own learning.

The study joins the discussion around developing new learner-centered culture in the area of more traditional pedagogical culture. To achieve learning results, students should be able to regulate their learning within different subject areas instead of just learning subject-specific skills or information. This kind of setting requires a change in the role of teachers. The key pedagogical element is the extent to which the teacher is able to support their students in improving their MA. This consideration created the basis for the research on teachers' support for learner MA in Study III.

4.3 Study III

Kallio, H., Kallio, M. Virta, K., Iiskala, T. & Hotulainen, R. (In print, accepted on February 18th, 2020). Teachers' Support for Learners' Metacognitive Awareness. *Scandinavian Journal of Educational Research*. <https://doi.org/10.1080/00313831.2020.1755358>

The importance of teacher support has been highlighted in previous studies (Cox & Williams, 2008; Ryan & Patrick, 2001) due to its significance in affecting learner achievement (e.g. Roorda, Koomen, Spilt, & Oort, 2011). This study focuses on MA as one of the most important factors of successful learning (e.g. Griffin, McGaw & Care, 2012), especially from the point of view of teachers' support. Therefore, the main purpose of this study was to investigate teachers' support for learner MA. Its specific aim was to explore perceived support for learner MA across different domains of teaching in relation to three main components: knowledge of learning objects, regulation of learning strategies and self-evaluation, each encompassing two sub-components.

The sample (N = 1,045) consisted of upper secondary VET subject teachers, GE subject teachers and special teachers in Finland. Teachers were compared to each other aiming to find out the extent to which VET subject teachers, GE subject teachers and special teachers differ in how they support learner MA. The extent to which subject teachers in VET and GE differ in how they support learner MA in their respective subject groups was also explored. Finally, the reveal of different background variables (in-service teaching experience, gender and qualifications) was investigated.

The Inventory of Teacher's Metacognition Support (ITEMS) was developed to assess teachers' perceived support for learner MA. This instrument is constructed on a theoretical model of MA involving eight factors, with three items in each. A similar kind of theoretical structure, but with two main components, is used in the validated scales the MAIT-18, utilized and explored in Study I, in the original MAIT (Balcikanli, 2011) and in the MAI (Schraw & Dennison, 1994) utilized in Study II. The instrument also draws on theoretical ideas about teacher support, such as 'A model of a powerful learning environment in teaching strategies' (De Bruijn & Leeman, 2011). The ITEMS-18 comprises three main components: knowledge of learning objects, regulation of learning strategies and self-evaluation (see Figure 3). All three main components were measured using two sub-components of three items each. In this study, self-evaluation is highlighted as one of the main components, along with knowledge of learning objects and regulation of learning strategies. The model in which self-evaluation acts as a reference component (see Figure 2) was used in Study II to explore the MA of VET students. In this study, "support" is the main concept and hence acts as the common denominator of every component of

MA in the ITEMS assessment tool. Following the example of the original MAI, the ITEMS consists of the entire set of eight sub-components with three items in each. However, in national learning-to-learn assessment in GE, the number of items in each theme was limited: a maximum of 18 items of MA could be included in the teacher survey. So, the inventory was adapted from a 24-item version (appendix 1 in Study III) to an 18-item version (Kallio, Virta, Kallio, Hotulainen, Lampi, Tamm & Ahtiainen, 2019).

The main finding of the study was that special teachers supported learner MA more than VET subject teachers and GE subject teachers. The findings also indicate that perceived support for learner MA varies across components within subject groups. A clear difference was found between genders, in that women systematically supported learner MA more than men for all components and across all teacher groups. Experienced teachers were found to support learner MA more, although the differences were relatively small. The teachers' academic qualifications were also used as one of the background variables. The results revealed that teachers with master's degrees were found to provide more support for learner MA than teachers with bachelor's degrees.

To summarise, the findings confirm the need to develop support for MA capabilities during pre-service and in-service teacher education, as lifelong learning requires learners to be aware of why it is important to learn, what is worth learning and how to learn it.

5 Main findings and discussion

This dissertation examined issues in perceived MA among teachers and learners. The issues of MA are discussed and studied theoretically, empirically and methodologically, aiming to deepen the understanding of teacher MA and to study how different teachers (subject teachers and special teachers in general education (GE) and vocational education and training (VET)) perceive their support for their learner MA. The assessed issues are discussed in light of the validity analyses and the reliability of the instruments used to measure MA.

The main findings of this dissertation demonstrate that MA can be measured with the chosen, validated and developed self-reports and is therefore a phenomenon that is possible to study quantitatively. Another challenge of conducting valid quantitative educational research is gathering a sufficient number of data from in-service teachers. These two challenges might be the reason why so little research exists on teacher MA, especially among in-service teachers. For this reason, valid and useful instruments to assess MA are needed.

Study I took steps to face the challenges of assessing teacher MA and explored the utility of the 18-item version of the MAIT (MAIT-18). Based on the encouraging findings of the study, it can be concluded that due to the solidness and convergence of the instrument, it can be expected to produce valid information on teacher MA. These findings encouraged to take the next step in studying the concept of MA. Hence, **Study II** took steps to deepen the understanding of the construct of MA theoretically, exploring the connections between the components of MA by examining how an individual's perceived MA can be categorized. Interconnections between the components of MA were empirically explored using path modelling. The study also examined which of the components of MA predict successful learning. In the study, it was confirmed that self-evaluation does not actually regulate the ongoing or forthcoming process, but is a tool used to reflect both knowledge and regulation of cognition.

The findings conclude that the conditions and goals appointed by the learner predict the selection of contents and strategies towards the self-evaluation of ones's own learning. In other words, by measuring planning or conditional knowledge, other components of knowledge or regulation and, especially, self-evaluation could

be predicted. The findings of **Study II** extensively confirm that planning and knowledge of conditions predict success throughout the learning process. The results give reason to encourage teachers to support students in improving their MA. It is especially recommended to strengthen the students' understanding that setting objectives for their own learning is the optimal starting point for all studying. **Study II** provided the information needed to understand the theoretical structure of learner MA and thus formed the basis for the extension of the study, concerning different teachers' perceived support for learner MA.

Study III described how GE and VET subject and special teachers (N = 1045) perceive their support for their learners' MA. Specifically, the study compared VET and GE subject teachers with each other and with special teachers. The main finding was that special teachers support learner MA more systematically than other teachers. The differences were substantial across all components with the exception of self-evaluation of knowledge of learning objects, in which VET subject teachers support their learners more than special teachers. The perceived support for learner MA varies between components and between teacher groups. However, systematic differences were found in all three main components (knowledge of learning objects, regulation of learning strategies and self-evaluation of learning objects and learning strategies) between VET subject teachers of social and health care and service sector teachers and VET subject teachers of technical subjects. In GE, the differences are not as systematic, but teachers of mathematics, physics and chemistry were found to support knowledge of learning objects in particular, while teachers of practical subjects such as crafts, music and art were found to emphasise support during the learning process. A clear and systematic difference was found between genders, as for all components and across all teacher groups women were found to support their learner MA more than men. Moreover, experienced teachers were found to support learner MA more, although the differences were relatively small. The findings of this study confirm the need to develop support for MA capabilities during pre-service and in-service teacher education as lifelong learning requires learners to be aware of why it is important to learn, what is worth learning and how it should be learned. The findings of the study indicate how teachers currently address this challenge.

In sum, the findings of all three sub-studies highlight the importance of MA in learning (see Griffin et al. 2012), especially teachers' capability to support their learners' MA. Along with lifelong learning and 21st century skills, learners need to be aware of their own learning to pursue the aims of the current educational requirements (see Dede, 2010; Bulut, 2018). The implications of the dissertation are categorized and presented theoretically, methodologically, empirically, and finally pedagogically and educationally in the following chapters. Some implications may be multifaceted and overlap with others, and therefore cannot be firmly categorized.

5.1 Theoretical implications

Two main components of MA, the knowledge of cognition and regulation of cognition, were used as the basis of the sub-studies in the dissertation, in order to clarify the theoretical aspects of MA and the assessment of learner and teacher MA. Study I relied on the theoretical framing of MA from previous studies in the research field in its data analysis, providing a tool to assess teacher MA. However, to deepen our knowledge of MA, especially considering the aim of the dissertation, the phenomena had to be studied more theoretically. To attain information on learner MA, Study II theoretically explored the main components of MA among students, focusing especially on self-evaluation.

The theoretical aim of Study II was to examine the extent to which learners' self-evaluation could be predicted by the MA components of knowledge of cognition and regulation of cognition. Therefore, the aim was also to explore whether self-evaluation could act as an independent main component. The findings confirmed that self-evaluation is a reference component between the main components of MA (Figure 4).

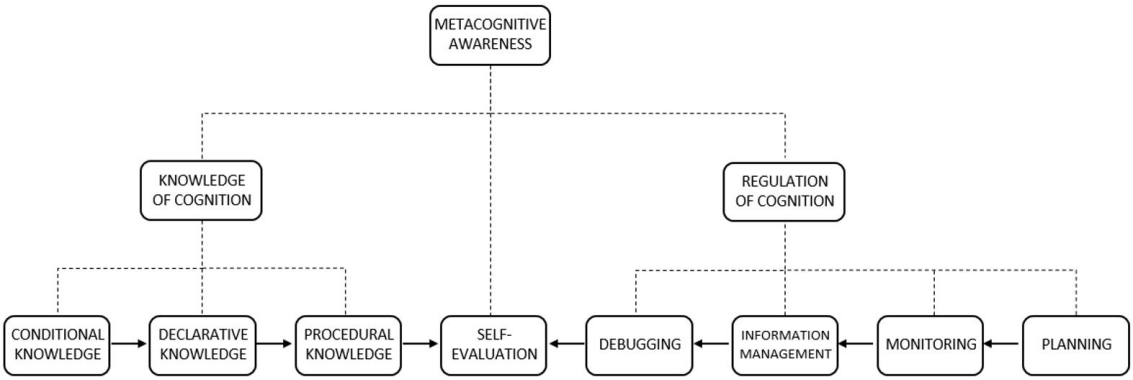

Figure 4. The components of MA in Study II.

In the components of knowledge of cognition, conditional knowledge is the first predictor for self-evaluation. It predicts self-evaluation directly (r = .44) and via the interveners (via declarative knowledge and secondly, via procedural knowledge). Declarative knowledge does not predict self-evaluation directly but rather acts as an intervener. Procedural knowledge acts as an intervener for both conditional knowledge and declarative knowledge. This final model is theoretically meaningful and fits the data. This path model of the components of knowledge of cognition in MA demonstrates that the contents of learning (described as declarative knowledge)

and then the learning strategies (described as procedural knowledge) are selected in order to achieve the learning goals described as conditional knowledge.

For regulation of cognition, the final model is supported by the theoretical background in which the component of planning acts as the first predictor for self-evaluation while monitoring acts as an intervener. This theoretical model of the regulation component of MA got excellent fit indexes. In the model, planning acts as the general predictor for the other components of regulation. Although the direct effect of planning on self-evaluation is statistically significant, it was found to be relatively low. Consequently, the interveners (monitoring, information management and debugging) play an important role in the regulation process. These interveners of regulation of cognition refer to the formative self-evaluation during the learning process. Therefore, findings of the low, although substantial effect of planning on self-evaluation is logical, since one cannot evaluate learning without having implemented any.

An important theoretical implication of the dissertation concerns the interdependence of the components of MA, of the component of self-evaluation. As mentioned before, MA has typically been divided into the main components of knowledge of cognition and regulation of cognition in previous research. However, as has been argued in this dissertation, the components of MA can actually act interdependently, overstepping the line between the main components. This view is also supported to some extend by some researchers (see Veenman et al., 2004; Efklides 2006). It is important to note this argument, since it has been cautioned that a total separation may lead to oversimplification (see Brown, 1987). The findings of Study II confirmed that self-evaluation can be treated as a third main component of MA, referring both to the knowledge and regulative part of individuals' MA of their learning. The path model reveals that planning is related to conditional knowledge through setting learning goals that the contents and strategies of learning are based on. Conditional knowledge and planning, appointed by the learner, both direct towards self-evaluating one's own learning. In other words, other components of knowledge and regulation and, especially, self-evaluation, can be predicted by measuring planning or conditional knowledge.

As confirmed in this dissertation, self-evaluation is the central factor in MA. Self-evaluation, directed at the operations during the learning activity, is usually described as formative evaluation. To evaluate learned matters at the end of the learning process, the operations are described as summative evaluation (Keeley, 2008.) Different teachers appreciate different methods of evaluation. Spokespeople of formative evaluation have appealed to the policies of the current curriculum according to which teachers should guide learners to evaluate their own learning during the learning process. Based on the theory of MA, monitoring as an operation during the learning activity represents formative evaluation. Therefore, to avoid

confusion between monitoring as formative evaluation and self-evaluation directed to MA entirely, self-evaluation was examined in Study II as a main component of MA instead of sub-component of regulation of knowledge. The findings of this dissertation reveal that self-evaluation focusing on the objects of one's learning, carried out at the end of and after the learning process, is a significant tool used to reflect both knowledge and regulation of MA.

As Study II confirmed, the path of the components of MA indicates that the contents of learning (declarative knowledge) and learning strategies are selected by the learner in order to achieve one's self-set goals (conditional knowledge). This leads to the supposition that in many cases the starting point for optimal learning could be a deductive approach because conditional knowledge controls learning activity. Laine's dissertation thesis (2019) studied learners' intrapersonal competence perceptions. According to Laine, the element of gaining knowledge about something new can be a source of interest for the learner. He refers to the knowledge-deprivation-hypothesis of situational interest presented by Rotgans and Schmidt (2017) that is generated when learners realize their gap in knowledge between what needs to be known of a topic and what they already know about it. This is followed by the need to support learners' declarative knowledge in a learning situation where the context and subject matter have already been marked off. This highlights the question of where to set the starting point for an optimal learning process.

The question is of whether and to what extent the starting point is deductive or inductive. When the learner is allowed or asked to set one's own conditional objectives, the learning is deductive. In an inductive learning process, following a declarative point of view, the objectives stem from the task and its contents, not from the person doing them. Therefore, intrapersonal competence perceptions can be assumed to be involved with conditional knowledge, since intrinsic motivation and individual interest are presumed to determine the learning objectives learners will set for themselves. It is also possible that it is too difficult for some learners to set their own learning objectives instead of having a teacher do it for them. Teachers may have different views on setting learning objectives because it depends on a number of factors: subject matter, student group, the teacher's concept of learning, curriculum, level of development of the learner or of the group of learners, and finally, the learners' MA level.

Leaning on these arguments, the main implications concern the components of conditional knowledge and self-evaluation. One of the main contributions of this work was to reveal that self-evaluation is actually not a sub-component of regulation of cognition but a significant tool to reflect an individual's MA as a whole. This aligns with Desoete et al.'s (2002) view that knowledge of cognition and skills in regulation of cognition form a cluster, and that conditional knowledge mainly relates

to predicting and evaluating. These arguments and the theoretical findings of Study II gave reason to explore these dimensions as interactive and overlapping components and tools. This approach is seen in the components of support for MA in this dissertation. Therefore, following the theoretical model of Study II, a new instrument called the Inventory of Teacher's Metacognition Support (ITEMS) was developed for Study III. The instrument was used to empirically examine teachers' perceived support for their learner MA across three different teacher professions (subject teachers in GE and VET and special teachers).

Along the findings of Study II, the new instrument was constructed based on the new theoretical model of the components of MA. The new model includes three main components, each consisting of two factors: knowledge of learning objects (conditional knowledge and declarative knowledge), regulation of learning strategies (learning strategy planning and monitoring & debugging) and self-evaluation (self-evaluation of knowledge and self-evaluation of regulation). Along the findings and implements of Study II, self-evaluation acts as a reference component between knowledge of cognition and regulation of cognition (see Figure 4). Therefore, self-evaluation was linked to both knowledge of learning objects and regulation of learning strategies (see Figure 1). Referring to the implications of Study II, these concepts were used in the inventory, since self-evaluation is regarded as a tool to evaluate one's learning objects and learning strategies.

In Study III, the ITEMS questionnaire's items of self-evaluation represent post-studying operations, focusing on conditional knowledge and declarative knowledge as well as on the planning of learning strategies. This can be theoretically considered as summative self-evaluation, with the exception of self-evaluation of monitoring and debugging that describe operations during the learning. According to educational theories, these are considered to fall under continuous self-evaluation, or formative self-evaluation (see Keeley, 2008). Discussing the advantages and drawbacks of formative and summative evaluation is not the task of this study, but I suggest that these two forms of MA self-evaluation should be examined in parallel, not opposed to each other.

5.2 Methodological implications

MA is a key to enabling teachers to reflect on their own work and the support they give their students, particularly with their MA. More research focusing on teachers' contributions is needed to achieve the goals of lifelong learning and learning to learn skills, where the learner is seen as an active and responsible actor (see Greene et al., 2011; Ministry of Education and Culture, 2014). Since teacher MA and especially the support point of view has only been studied to a limited extent, it would be highly important to gain more detailed empirical research in the field. Therefore, different

methodological research is needed to develop tools for this purpose. Assessment issues are discussed in light of the reliability and validity analyses of the instruments used to measure MA. The methodological procedure of the analysis is described in more detail in Chapter 3 and in the original publications.

One of the methodological aims of the dissertation was to validate the instrument of teacher MA assessment, the MAIT, for national use, which Study I accomplished in. For Study II, the validation of the instrument of learner MA assessment, the MAI, for national use was carried out similarly. Study I explored the utility of the 18-item version of the Metacognitive Awareness Inventory for Teachers (MAIT-18). The results reveal that the fit of the factor structure of the entire questionnaire was good/acceptable within the separate groups of the participants, irrespective of gender, academic degree or qualification details. The CFA indicated convergence of each factor. Moreover, alpha scores of the inventory signify that the inventory is internally consistent. The results of the study revealed that the MAIT-18 can be expected to produce valid information on teacher MA because of the solidness and convergence of the instrument. It is also a valid tool for comparable data acquisition among in-service teachers. Since the MAIT-18 enables the study of large sample groups and can be used in comparable studies in different cultures of learning and teaching, it enables the development of international co-operation in educational research.

In Study II, the MAI was validated for the methodological purpose of studying MA among learners and of examining MA theoretically. As in the earlier studies using the MAI scale, the internal consistencies of the entire questionnaire and of the components separately were found to be good. The theoretical structure of the components was confirmed using CFA. The analysis took place within regulation of cognition and knowledge of cognition, separately. Knowledge of cognition consisted of three factors: conditional knowledge, declarative knowledge and procedural knowledge. The fit of the model was acceptable/good. As in the original factor structure of the MAI, self-evaluation was analyzed within regulation of cognition. Hence, the component consisted of five factors: planning, monitoring, information management, debugging, and self-evaluation. The analysis also confirmed the theoretical factor structure. All factor loadings of the items were statistically significant. The CFA revealed that the components were composed without difficulties. According to the findings of Study II, the MAI is a valid instrument to study adolescent and adult MA in accordance with the purpose of its original version. Therefore, the methodological aim of validating an assessment tool with which student MA can be measured and modeled following the theoretical framework was fulfilled.

To summarize, the findings of Study I and Study II confirmed the implications and findings of previous research that individuals' perceived MA is an assessable

phenomena (Schraw & Dennison 1994; Schraw & Moshman, 1995; Young & Fry, 2008 Balcikanli, 2011) and that it can be measured using self-report questionnaires which are confirmed to be valid in their research contexts. Therefore, collecting data using self-report questionnaires is considered to be an appropriate method of studying MA, especially with larger groups (Sperling et al., 2002). Encouraged by the methodological findings of Study I and Study II, a new empirical tool was developed to assess teachers' support for their learner MA.

The final methodological aim was to develop an instrument to study teachers' support for learner MA in Study III. The 18-item questionnaire Inventory of Teacher's Metacognition Support (ITEMS-18) was adapted from its original 24-item version (Appendix 1 in Study III) for this purpose (Kallio, Virta, Kallio, Hotulainen, Lampi, Tamm & Ahtiainen, 2019). The ITEMS-18 is comprised of three main components: knowledge of learning objects (F1 & F2), regulation of learning strategies (F3 & F4) and self-evaluation (F5 & F6). All three main components were measured using two sub-components of three items each (see Figure 5).

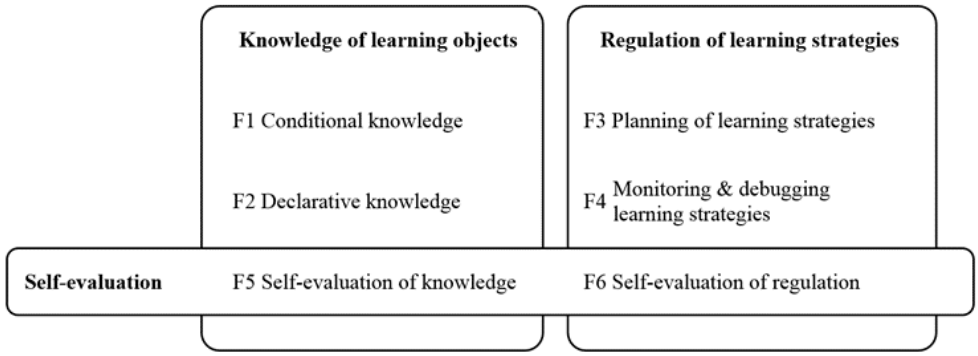

Figure 5. Factor structure of ITEMS-18.

The factor structure was measured and tested using CFA, which verified the fit of the factor structure based on several indexes. The analysis revealed good/acceptable fit for the factor. The factor structure of special teacher data showed the best fit. This was to be expected, as conceptions of learning are assumed to be well known within the expertise of special teachers. Another expected finding was that the factor structure of the knowledge of learning objects showed better fit with the data.

Methodological considerations

This chapter discusses the methodological considerations concerning this dissertation thesis as a supplement to the methodological considerations concerning most of the studies on MA presented in previous chapters. In addition to being

justifiable from the point of view of this thesis, the methodological approach also has its weaknesses as described in previous chapters. Thus, the limitations regarding the usability of the findings of the empirical studies of this thesis need to be taken into consideration. First, due to the sample size of Study I and II, no generalized conclusions can be drawn. Secondly, in Study II, the theoretical model of MA is empirically studied among VET students, and therefore, generalization of learner MA cannot be concluded. Using a mixed approach employing qualitative and quantitative methods is often highly recommended. This is understandable in cases in which more reliable and valid information can be obtained using these methods. For example, using self-reports in conjunction with other methods, such as interviews or objective behavior measurements, i.e. systemic observation and think aloud protocols, could possibly attain a wider perspective of learner and teacher MA. In the present thesis, think aloud method was used for pilot groups in pretesting the measurements. The teachers were asked to present their questions or notes instantly similarly as the student pilot group. Students were also asked to pay special attention to possible unfamiliar concepts or unclear statements, and to present their questions or notes instantly.

A more objective perspective could especially be attained by observing what happens in classrooms. However, in studying perceptions of MA, this method is sometimes considered controversial, due to its implementation with a small number of students and difficulty of student control (Akturk & Sahin, 2011). Think aloud protocols are also criticized in research of metacognition as they may prevent students from learning while they express their MA verbally (Akturk & Sahin, 2011; Scott, 2008). Therefore, to understand disparity between various assessment methods, more research with multi-method designs in MA is needed (Veenman, Van Hout-Wolters & Afflerbach, 2006). However, using prosodic analyses to study the meaning of the perceptions of paralinguistic and nonverbal features of speech would broaden the understanding of both learner and teacher MA in classroom discussions (see Hämäläinen, De Wever, Waaramaa, Laukkanen & Lämsä, 2018).

Considering the employment of the methods, they should not be chosen only for their intrinsic value. Apart from the positive aspects of interviews, in contrast with self-reports, they may not attain equality for all students in the collection of data (Akturk & Sahin, 2011), and they require a mutual and interactive communication process that cannot be implemented in a classroom environment (Scott, 2008). Hence, in Study III, because of the large sample size, it might not have been useful to bring out the individual teachers' views and perceptions through interviews. The individual perceptions would have possibly become overly emphasised in the reader's eyes, standing apart from the wider picture. Due to the large sample size, general conclusions can be drawn in this study.

Currently, as online learning has become more popular, discussion over the necessity and potential of temporal analysis in studying MA is necessary. Novel methods are needed to analyse MA in learning processes. In online learning contexts, lag sequential analysis (LSA) (Bakeman & Gottman, 1997) could be useful in investigating temporality (Lämsä, Hämäläinen, Koskinen, Viiri & Mannonen, 2020). Using LSA denotes conceivable explicit monitoring of time or the duration of the specific learning activity (Knight et al., 2017), which closely refers to the self-evaluation on regulation of learning strategies. Moreover, by using temporal lag sequential analysis (TLSA), that also provides insights on the behaviour patterns of the learning processes (Lämsä et al., 2020), it is possible to add value in comparing the learning processes between different groups.

5.3 Empirical implications

One of the aims of the dissertation was to empirically examine the extent to which students' self-evaluation could be predicted by the components. The findings of Study II showed that the vocational students' knowledge and regulation of cognition follow the theoretical assumptions of MA. These results do not report the extent to which vocational students are aware of their metacognition, compared to, for example, more academically oriented students. However, the findings of this study extensively confirm that planning and knowledge of condition predict success throughout the learning process which is in line with the principle of learning to learn.

The results of Study II revealed that the composed models of MA in both knowledge of cognition and regulation of knowledge work for both genders and all age groups but are not as suitable among young men as for other observed groups. One possible explanation could lie in developmental psychology, according to which cognitive abilities develop earlier in girls. The advantage for girls has been shown in several studies (see Forsthuber, Horvath & Motiejunaite; 2009). For example, girls tend to reach higher reading achievements than boys. The gender gap emerges early and is maintained with age. This is in line with the findings of the latest results of the OECD's PISA survey (OECD, 2019) and with the study of Niemivirta (2004), who studied a group of practice-orientated students and a group of academic-orientated students in their last year of comprehensive school and vocational educational. He found that the number of girls in the academically oriented group exceeded expected values and vice versa in the practice-orientated group.

Another reason for why the instrument was found less suitable among young men than among other groups could be that young men might not have focused on the questionnaire as much as other groups. Furthermore, the explanation might lie in the differences between VET study programs. However, the latter explanation is

difficult to explore. It is also unclear whether gender explains differences in the selection of the training program or whether the training program is an explanatory factor in itself.

In VET, specific predetermined contents and processes have been a central part of teaching. The subjects in VET also appear to be more practical than academic. Before the criticized reform of vocational education that was implemented in Finland in 2018, vocational studies used to contain a lot of contact teaching. After the reform, the students' responsibility for their own learning has been increased, and the number of lessons has been reduced. Today, as the reform has been carried out to its full extent, the need to educate teachers to support learner MA is highly relevant. Discussion on whether and to what extent students of practical subjects are able to regulate their learning independently is needed in the field.

Study III empirically examined how teachers' perceived support for learner MA appears across different domains. The ITEMS-18 inventory was used for the examination. In earlier studies, MA has usually been divided into knowledge of cognition and regulation of cognition. However, as it has also been argued that knowledge and regulation can be interdependent (see Veenman et al., 2004; Efklides 2006), the study examined the dimensions as interactive and overlapping, as seen in the components of support for MA. In the study, the concepts of knowledge of learning objects, regulation of learning strategies and self-evaluation are the main components of MA. They include the sub-components of conditional knowledge, declarative knowledge, planning of learning strategies, monitoring & debugging, self-evaluation of regulation and self-evaluation of knowledge.

The differences in teachers' perceived support between the teacher groups were found in the analysis. The findings indicate that special teachers support learner MA more than VET teachers and GE subject teachers. The differences were statistically significant for all other components except self-evaluation of knowledge of learning objects, in which VET teachers supported their learners more than special teachers. The biggest differences were found in favour of special teachers. The differences related to monitoring and learning strategy debugging were remarkable, especially when compared to VET teachers. The difference in support of self-evaluation of learning strategies at the end of the learning process was also as significant between these two teacher groups.

The expected result was that special teachers would be orientated towards supporting learning skills, described in the study as regulation of learning strategies. However, VET teachers got higher scores in support for their learners' self-evaluation of learning objects. This result might be explained by content orientation within each area of specialisation. Another explanation for VET teachers' high scores may be connected to the transformed evaluation of studies in VET. With the previous reform of vocational education, the earlier definition of credit points was

changed into an assessment of competence. This might have possibly led teachers to guide their students to evaluate their own learning objects.

According to the findings of the study, teachers' perceived support for their learners' MA varies across components within subject groups. However, social and health care and service sector teachers in VET were perceived to support their learner MA more than teachers of technical subjects. There were systematic differences across all three main components (knowledge of learning objects, regulation of learning strategies and self-evaluation of learning objects and learning strategies). It is difficult to find an explanation for these findings without further studies. Could one explanation be found related to the responsible character of the social and health care sector's job descriptions? Are the teachers in the educational sector of social and health care pushing themselves to support their students to learn the level of responsibility needed for their future jobs? And do these teachers expect self-regulative learning from their students more than other VET-teachers, especially those in technical subjects?

In GE, the differences are not as systematic. However, teachers of mathematics, physics and chemistry supported the knowledge of learning objects in particular. This could be related to these teachers' opinions on the importance of enhancing their learners' logical thinking and ability to solve mathematical problems in general. It was also found that teachers of practical subjects such as crafts, music and art emphasise supporting their learners' MA during the learning process.

In the analysis of the measurement scale, the best fit was found with the special teacher data and the least fit with subject teacher data. This may be because subject teachers might have been less familiar with the questions and concepts of the questionnaire. This might also explain to some extent the variation across subject teachers in relation to the main components and pairs of components. The results suggest that special teachers are experts in matters of learning. This claim is supported by the fact that special teachers' major subject in university is science of education, whereas subject teachers are only required to take it as a minor subject and therefore cannot be expected to possess the same level of expertise in educational questions.

A clear difference in support of MA between genders of the teachers was also found. Female teachers were found to systematically support learner MA more than men in all components and across all teacher groups. The most notable differences were found among special teachers, where women supported their learners' regulation of their learning strategies significantly more than men. Among VET teachers, women supported their learners' knowledge of learning objects more than men. These differences may reflect female teachers' reputed conscientiousness, whether as teachers or as questionnaire respondents.

However, it remains unclear whether the support of MA could be explained solely by the gender, subject group or the didactics of the subject. In addition, every school or educational institute has a learning culture of its own. Questions of which factors learning culture consists of and to what extent learning culture is affected by the leadership of the educational institute are issues for further studies.

When examining age distribution among the teachers, it was found that the majority of GE subject teachers were younger than VET subject teachers. The reason may be that different teacher groups have been schooled in different eras of teacher education and have been taught different concepts of learning and teaching as a result. Teachers who have been working for a longer time may follow an established model of teaching with a so-called traditional teacher-led teaching approach. The current learner-centered, 21st century learning approach may thus be a foreign concept to them. However, the concepts of learning or teaching were not examined in this study and therefore conclusions cannot be drawn on this basis. Learner centrality has already been emphasised in some form or another for as long as general education has existed in Finland from the 1970s. It is obvious that the present form of learning instruction deviates from the pedagogic starting point of GE. In the 1990s learner centrality was emphasised in teacher training. However, the transition of practices from teacher education to the established practices of in-school teaching takes time.

Traditionally, in educational research, it is not an unconventional task to find out what causes the variance behind students' successful learning. Hattie (2003) assumes that teachers are the greatest source of variance that can make the difference in student's achievement, and therefore suggests that we should focus on them to truly make a difference. The differences between expert teachers and novice and experienced teachers are discussed in his review (2003). One should note that the definition of expert and experienced teacher must be distinguished, since they do not necessarily mean the same thing (Berliner, 2001, see also Glaser 1978,1990). Therefore, in this thesis, only the concepts of novice and experienced teachers were used. In Study III, experienced teachers were found to support learner MA more, although the differences were relatively small. This finding is somewhat unpredictable, as MA is a relatively new concept in education. The increasing emphasis on learning skills in teacher education over the last decade may lead to a situation where younger teachers are better prepared to deal with metacognition in their teaching practices. On the other hand, novice teachers tend to concentrate more on content and learning outputs while senior teachers place more emphasis on the procedural aspects of learning. This is in line with Messmann et al.'s study (2010), which states that younger teachers may not be as capable of reflecting on their work as older teachers.

Closely connected with Study III, Wolff, Jarodzka, van den Bogert and Boshuizen (2016) studied experienced secondary school teachers' and novice teachers' perceptions of learning. In their study, they found the difference between the two types of teachers to be statistically significant, contrary to the findings of this thesis. They found expert teachers to focus their attention on areas where relevant information was available, as their perception appeared to be more knowledge driven. Furthermore, expert teachers monitored and used words referencing cognition more than novice teachers. Novice teachers' attention was found to be more scattered across the classroom, which is in line with Berliner (2001), who found that novices are likely to miss features that experts continually monitor (see also Boshuizen and Schmidt, 2008). Therefore, drawing a conclusion, together with the findings of this thesis, differences between novice and experienced teachers were also found in supporting monitoring and debugging, which is the sub-component of regulation of learning strategies. Statistically significant differences were found in the support for knowledge of learning objects, the main component of teacher support for MA. Compared to Study III's findings of experienced teachers supporting learner MA more, a very interesting finding was found in study of Schempp, Tan, Manross and Fincher (1998). According to their study, novice teachers focused on subject matter activities in learning and teaching, while experienced teachers responded more to their students' needs in learning. This might refer to the fact that the novice teachers would concentrate more on declarative knowledge, whereas the experienced teachers focused on conditional knowledge, paying more attention to learners' individual objectives of learning based on their needs. Also, as Schempp et al. found, the experienced teachers perceived themselves as responsible for learner difficulties, trying to seek ways to solve problems their learners encountered. Furthermore, they found that novice teachers used tradition to justify their content selection and authority as teachers, while experienced teachers selected content based upon logical or technical reasons. This might be connected to the findings of experienced teachers supporting learner MA more.

Moreover, teachers with master's degrees were found to provide more support for their learner MA than teachers with a lower degree. This was especially true for regulation of learning strategies during the learning process and self-evaluation at the end of the process. They also provide more support for their learners in relation to conditional knowledge.

5.4 Limitations of the study

This study is a quantitative survey and is hence affected by the limitations of that research genre. The use of qualitative methods might have resulted in a more diverse perspective and exploration of relationships within the intricate layers of MA.

However, this would have only been possible with a very narrow sample group. Statistical results of teacher MA and their support for student MA might differ to some extent from what qualitative examination of classroom behavior would produce.

The use of self-report instruments may create limitations in research. According to Schellings et al. (2013) the limitation is usually due to the narrowness of self-report instruments. Some researchers (e.g. Veenman, 2011) suggest using thinking-aloud methods instead of self-reports to avoid limitations stemming from the respondent not being completely aware of ongoing processes. Verbalizing these processes in self-reports may also cause some problems for the respondents. Despite these limitations, off-line self-reports have their advantages, especially in theoretical research of large sample groups (e.g. Pereira-Laird & Deane, 1997; Sperling et al., 2002).

MA assessment also has its limitations. Criterion validity needs to be estimated simultaneously with MA assessment, and should be estimated in relation to other scales, such as cognitive performance factors. The use of the compressed versions of the questionnaires is required, because respondents can only concentrate on a limited amount of questions at once. However, since the three-item structure is optimal in terms of reliability requirements, the inventories used in this dissertation are of high value for further research.

Another limitation of this study concerns the conceptualization of support. In this study, a theoretical description of support was influenced partly by the study of De Bruijn and Leeman (2011). However, no category or instrument was found to be suitable as such for use in this study. Therefore, the development of a new instrument was needed to assess how teachers perceive their support for learner MA. However, the assessment of support for MA should be developed and studied further.

Finally, it is unclear whether some of the results of Study III were caused by the characteristics of teacher education or specific school subjects. It is also unclear whether the results reflect the culture of the educational institutions. In the future, it would be interesting to study the factors behind student MA and teacher support.

6 Conclusions

The purpose of this doctoral thesis was to deepen existing understanding of teacher MA, especially aiming to examine how teachers support learner MA. Taken together, the importance of MA to learners, teachers, providers of education, to teacher education, to the education political decision-makers and research on educational science are finally summarised. While the findings and implications of the dissertation are specific to the three studies and should not be generalized, some general aspects can still be construed. Chapter 6 discusses how the results of this study can be utilised to direct education at different levels and domains, and which research topics need to be examined in more depth in the future.

6.1 Pedagogical and educational implications

In this study, MA was examined according to the theories of knowledge and regulation of cognition, connected by self-evaluation. In order to adopt, develop and strengthen understanding of the complex and multi-faceted MA, the learner needs substantial practice with support from their teacher. The teacher has a substantial role in reaching this objective. Support for MA should become a long-lasting feature of lifelong learning and teaching and therefore, teachers need more education in it. In Study II, self-evaluation as part of MA was studied theoretically and empirically. The research results showed that self-evaluation has an important connection to all the components of MA, as it is directed to both knowledge of cognition and regulation of cognition. The results of the empiric study showed that this applies to both the learners and the teachers. Based on the results, it is important that both the learner and the teacher can reflect the learning objectives set by the student on their operations. The student reflects their thinking on their learning process and the teacher on their teaching.

Study III empirically examined teachers' perceived support for MA. The results showed that different teachers have different views on the importance of support for MA and that they differ in their support in MA. Results from assessing teachers' views on how they support the setting of learning objectives are especially interesting: do learning objectives stem from the task or from the learner? If the

objectives are set by the learner, the learning process is based on conditional knowledge of their own. This approach is described as deductive one.

If the learning objectives are based on the contents and context of learning, or declarative knowledge, the learning process is described as inductive. The path model of MA in Study II shows that declarative knowledge acts as an intervener, whereas conditional knowledge is the first predictor for self-evaluation. Procedural knowledge acts an an intervener for both conditional knowledge and declarative knowledge. Self-evaluation is linked to all the components of MA, which highlights the importance of supporting it in teaching. Therefore, teacher support, especially with self-evaluation of MA, strengthens learners' regulation of their learning in terms of their own objectives.

A number of studies (see Greene et al., 2011; Dede, 2010; Bulut, 2018) have demonstrated the importance of teaching and learning metacognitive skills to enhance lifelong learning. In order to help learners attain MA, which acts as a foundation for lifelong learning processes, support for MA capabilities must be developed during pre-service and in-service teacher education. This dissertation theoretically clarifies that conditional knowledge, planning and especially self-evaluation are clearly interconnected and are the most essential components of MA to be taught. This means, as assumed, that setting personal goals for learning is the central element of MA in learning and should be the starting point of learning and teaching MA. Setting goals of one's own results in optimal self-evaluation of one's learning. Planning the learning process after setting goals forms a meaningful basis for learning.

As in Study II concluded, planning is the general predictor for the other components of the regulation of cognition, althoug the direct effect to self-evaluation is relatively low. Therefore, the interveners monitoring, information managements and debugging have crucial role. Teacher education could be improved to promote the MA of pre-service teachers in light of these findings. The key pedagogical element is the extent to which teachers are able to support their students in improving their MA. This study joins the discussion around developing new learner-centered education culture within an area of more traditional pedagogical culture. Today, the international trend of emphasising learners' responsibility for their own learning highlights the importance of metacognitive understanding and awareness at all levels of education (see Griffin et al., 2012). This kind of setting requires a change in the role of teachers. Flipped learning, when understood as an ideology of learning, not a method of teaching (Toivola, 2016), shares a similar ideology of the active role of students and the supporting role of teachers. According to Bergmann and Sams (2012), this role means providing learners with the tools and materials to learn by helping them develop a plan for how and when they will learn.

For policymakers, the challenge lies in ensuring that teachers have enough resources to support learners in this regard. Paradoxically, reduced funding means that learners are sometimes required to take control of their own learning to minimise teaching hours. These two moves should not occur simultaneously, as learners require high-quality support from teachers when taking control of their own learning. The minimization of teaching and contact lessons can be especially harmful to learners with low levels of motivation and insufficient studying skills. Lack of motivation can result from not getting accepted into a desired educational institute or not having concrete plans for the future. Some people end up pursuing second or third choice studies because of these reasons. In VET, the model of studying has been reformed to move from contact teaching towards self-studying. It is obvious that the present model does not suit the needs of students with learning difficulties due to poor learning skills. Another, totally separate, question is what must be taken into consideration in educational planning and implementation if secondary education is made obligatory, as outlined by the new government of Finland.

Learners constantly face situations where new tasks require knowledge and skills they have not yet learned. This is when specific prior knowledge or skills cannot be relied on, and general MA is needed to solve the problem. In order to use general strategies for new or challenging tasks, learners need to know about different general learning and thinking strategies embedded within the usual content-driven lessons in different subject areas (Pintrich, 2002.) Therefore, since MA is not only domain specific but also domain general, flexible and teachable (Schraw, 2001; see also Wolters & Pintrich, 2001), one should invest in developing it. It would be especially important to discuss MA with the learners by naming and using the concepts of MA to make the implicit phenomenon explicit (Pintrich, 2002) and more concrete and useful. This would allow learners to reach the next level in their learning by applying a generalized strategy to new situations (see Hacker et al., 2009).

To summarise the practical implications of this discussion, three principal points of learner benefits concerning MA are presented next. In sum, I would encourage teachers to:

1. help their students understand the concept of MA by making it explicit. This can happen through discussion and the theoretical examination of the phenomenon, naming the components of MA and attempting to identify them in learning and using self-evaluation tools such as questionnaires like MAI with the goal of proceeding from a general level to a personal level.
2. help their students identify which of the MA components they use (or don't use) in their own learning. It is important to identify personal strengths and weaknesses in using MA.

3. help their students use MA in their studies by utilizing their strengths and acknowledging their weaknesses in MA and by adapting MA to different situations and learning contexts. The aim is to acquire a strong tool to help with lifelong learning.

The learner needs the teacher's support at all these levels of MA development. However, in order to be able to provide support, the teacher must first understand MA thoroughly. The teacher profession is multidimensional and the professional picture between different teachers can differ. Furthermore, a teacher's concepts of learning and teaching can affect their professional profile and teaching methods. The concepts of learning and teaching internalized by the teacher depend on their personal experiences, their education and mentoring and the culture of their working community (Kallio et al., 2019). In the concepts of learning and teaching, there have been variations between separate teacher education periods. Teachers' concepts of learning and teaching can be presumed to be connected to those adopted during their own education. This could partly explain why the MA (along with the concepts of teachership, teaching and learning) of teachers varies between groups. The change in the role of teachers from distributors of knowledge to supporters of learning has been emphasized by changes in the concept of learning (Kallio et al., 2019).

The question of the deductive and inductive ways of learning connected to teachers' support for learner MA was mentioned in Chapter 5.1. In an inductive model of support for MA, the focus of learning is on the context and content of learning. Instructions for the learner might be along the lines of "if you do this, you will learn these…". In a deductive MA support model, the focus is on thematic entities, with learner-defined goals. This deductive model is aligned with present favourite concepts of learning, from the constructive concept of learning to the flipped learning model. Flipped learning (see Toivola, 2016) shares the same kind of ideology of the active role of the student and the supportive role of the teacher. Bergmann and Sams' (2012) idea of the supportive role of teachers involves providing learners with the tools and materials to learn and helping them to develop a plan for how and when they will learn. According to these learner-centered trends, learning is not based on information but on need. The learner will analyse what kind of information they will need to search for, leaving the final result open.

This dissertation examined VET and GE subject teachers and special teachers. These teachers are connected professionally by several factors: proficiency in the same subject between GE and VET subject teachers, and student age group and school context between special and subject teachers in GE. Furthermore, all the teachers have a substantial role in the learning and development of their learner MA. The time of transition between GE and VET has remarkable impact on an individual's MA development as part of a learner's growth journey from youth to early adulthood (see Veenman, 2015). Helping the learner become rooted in the

basics of MA during this period is largely the teacher's responsibility. The teacher's own MA should create a solid base for understanding the importance of support for learner MA. Supporting learners in attaining MA is the foundation of life-long learning processes. Therefore, I would highly recommend that the importance of MA is considered when developing both pre- and in-service teacher education and planning future pedagogical research.

It has been argued that political decisions to reform vocational education have led to a reduction in lessons. These decisions have been criticised on multiple grounds. **For both learners and teachers**, a reduction in lessons means less traditional contact teaching, and more responsibility being placed on students. If the increase of the number of contact lessons occured towards the situation before the reform, it must not lead back to the traditional teacher-directed learning but encounters between teacher and learner are needed in order to carry out true support for learner MA. Modern teaching methods and learning styles that meet the requirements of 21st century learning should be required across all educational levels and domains. It is obvious that these methods will change with the trends of learning to learn and self-directed studying.

Therefore, MA is becoming an increasingly important resource **for learners** in this new learner-centred educational culture and later in their working life, as learning is expected to continue throughout their life. **For teachers**, this means a new, more supportive role. However, to be able to support their learner MA and to understand and regulate their teaching, teachers are required to first attain MA of their own. **For education providers and teacher education** this means checking and developing the contents of teacher training and increasing resources for in-service teachers' further training. This calls for **the education of political decision-makers** for more careful consideration and wisdom to direct funds towards improving education to meet the future challenges predicted by present trends. Finally, **for research on educational science**, this dissertation will offer new perspectives and instruments to examine the current demand for learner and teacher MA. Moreover, knowing the importance of teacher support for learner MA, this dissertation will hopefully inspire and aid further research on the topic.

6.2 Directions for future research

Teachers experience the complexity of learning and teaching to learn every day, which necessitates their ability to continuously regulate their own cognition of learning (Hartman, 2001; Kramarski & Michalsky, 2009; Lin et al., 2005). Therefore, teachers need to know more about their own MA; how they reflect their teaching, what they should pay attention to and what should they develop in terms of their MA. Learners need to be supported in developing their MA to aim for success

in learning abilities, further studies, and employment. However, teachers must first be aware of their own MA abilities to be able to help their students to learn to improve their MA. According to Hämäläinen and Cattaneo (2015), teachers must adjust to numerous ways of modifying their instructional activities with their learners (see also Van der Zande et al., 2012), in order to fulfill the requirements of different learning contexts.

Teacher education could be improved by focusing on monitoring and developing pre-service teachers' preparedness in MA to enable them to enhance the MA of learners. Since teacher MA has only been studied to a narrow extent, it would be highly important to conduct more detailed empirical research in the field. As Messmann et al.'s study (2010) demonstrates, teachers, teacher educators and school leaders must all be aware of many factors due to their metacognitive dimensions of professionalism, especially in complex contexts and during periods of change. In line with the findings and implications of the three studies of this dissertation, some suggestions for future MA research are presented next. The suggestions follow the line of lifelong learning and 21st century skills in educational policy.

Study I's aim of exploring the utility of the MAIT-18 for comparable data acquisition among in-service teachers was fulfilled. The findings make future comparative and longitudinal studies of in-service teachers and pre-service teachers prospective. The MAIT-18 can be utilized for a wide acquisition of teacher MA data and further studies in developing teaching and learning culture in teacher training. It would be possible to begin a national or international project for developing much needed MA education for teachers based on the results of Study I. This study provides the tools for further research, recognizing the necessity of further comparative studies of in- and pre-service teacher MA.

The results of Study II revealed that the composed models of MA for both knowledge of cognition and regulation of cognition fit both genders and all age groups. However, young men do not fit the model as well as other study groups. This finding is interesting and gives reason for deeper exploration of the issue in the future. It would also be essential to study the extent to which instric motivation and other background variables of learning success relate to conditional knowledge and how that relationship is linked with optimal learning results. Research on the connections between components of MA and intrinsic motivation would deepen our understanding of learner MA and aid research and education of teacher support for learner MA.

According to the findings of Study III, teachers across different domains, with different specialisations and in different educational environments support for their learner MA differently. These findings indicate that special teachers support their learners' MA more than VET subject teachers and GE subject teachers. Reasons behind these findings could be investigated in further studies. It would be fruitful to

find out which elements of special teacher education strengthen their preparedness to support MA. If those elements were to be discovered, they could be included in teacher education and supplementary education could be provided for in-service teachers. Moreover, further research could study how much the differences between teachers are caused by differences in their education, or alternatively, the extent to which their personal characteristics or motives direct them to different teacher professions.

The expected result was that special teachers would be the most orientated towards supporting learning skills, or regulation of learning strategies. However, Study III discovered that VET subject teachers received higher scores in their support for learners' self-evaluation of learning objects. Whether this could be explained by each area of specialisation's content orientations is a potential topic of research for future studies.

According to the findings of Study III, teachers' perceived support for learner MA varies across components of MA within subject groups. In VET, however, social and health care and service sector teachers support their learner MA more than teachers of technical subjects. Systematic differences were found in all three main components of MA (knowledge of learning objects, regulation of learning strategies and self-evaluation of both learning objects and learning strategies). Explanations for these findings could be explored in further studies. One explanation could be found related to the responsible nature of social and health care work. Teachers in the educational sector of social and health care probably tend to support their students more in assuming responsibility to meet the demands of their future jobs. Also, these teachers may expect more self-regulative learning from their students than other VET-teachers, especially compared to technical subjects. Additionally, since the concept of MA is relatively new, it was somewhat unpredicted that teachers with longer in-service experience were found to support for learner MA more than novice teachers. Although the differences were relatively small, this may be of interest for further studies.

CFA revealed the higher utility of the ITEMS questionnaire for special teachers, indicating that the concepts of this study are more familiar to them than to other teachers. On the other hand, the higher scores of senior teachers in supporting their learner MA highlights the value of in-service experience. To share the benefits of recent teacher education and knowledge of best practices of MA, junior and senior teachers should be encouraged to collaborate more closely. It would be interesting to know whether institutes and schools differ in this regard.

Teachers possessing a deep understanding of the complex issues of metacognition is crucial for learners (see Vollmeyer & Rheinberg, 1999). Therefore, it would be very useful if further research combined data on learner MA with data on teacher support for MA to further explore how the two are linked. A review of

recent literature confirms that teachers' own MA strengthens their learner MA, equipping the learners toward calibrating and self-regulating their learning, leading to higher academic achievement (see Wilson & Bai, 2010). As the world becomes increasingly technical and complicated, we need a fuller understanding of how human activities, technology and nature interconnect as the basis for a new vision of professionality. Being an expert no longer means being a specialist in one field but in a network of fields. For students, this means a new role as lifelong learners, grounded in an understanding of *why* it is important to learn, *what* is worth learning and *how* it should be learned. In short, learners need to develop their MA, and teachers need to be able to provide support for that exertion.

One of the main conclusions of this dissertation is the important role of the component of self-evaluation. In Study II, it was methodologically confirmed that self-evaluation is linked to both knowledge of cognition and regulation of cognition. This finding should be considered in future studies of MA. Teaching methods and teacher education need to be developed and more research on the matter needs to be produced in light of these findings. If teachers support their learners to understand, to use and to strengthen the self-evaluation of MA as a whole, the learners will benefit their learning to learn and lifelong learning capabilities, pushing them closer to the objectives of 21st century learning.

If plans to make upper secondary education compulsory in Finland will be realized, it is obvious that more input into teaching will be required. We need teachers who know how to support learner MA at all levels – not just the ones with poor MA but also those who command the regulation of their learning well. Learners with prolonged studying difficulties especially need support for MA. Such learners might have been unable to enter working life for the same reasons that have hindered their studies. Learners suffering from lack of motivation in their studies or working life have an even stronger need for support for MA. It is clear that learners need MA in their studies and even more so later on in their working life. The concern is for the ability and desire of these learners to discover what, why and how to learn. Such ability is presumably scarce and therefore, teacher support for their MA here is essentially important. Only a well-educated teacher who has studied the matter and who has the time to provide support can help the learner. How capable are teachers of offering their support in MA that is required for learning? Why, how, what, when and what comes after? These questions should be examined in more detail in the future.

This doctoral thesis examined relatively large sample groups to obtain information about MA at a general level. Despite the limitations of the thesis, the results of the sub-studies were promising and indicated that the self-reports used and validated in the thesis have a potential to serve as measurements in studying MA. Especially, as a lack of appropriate assessment methods has been stated as an

obstacle to the improvement of researches of MA, the need for useful measurements continues (Akturk & Sahin, 2011). Therefore, this direction of research can be considered as a step forward in taking advantage of combining the theoretical knowledge of MA to improve the quality of self-reports. For future research, there is a need for more systematic empirical studies that focus on MA in more detail, especially the connection between learner MA and learning outcomes and the connection between the MA of teachers and their learners. In future studies, using a combination of online methods and questionnaires could also generate more profound information about individual people's MA. This would make it possible to examine the background variables behind the MA of specific persons, for example, using stimulated recall-method to study MA in classroom situations after evaluating perceived MA by answering the questionnaire. This multi-method could be expedient in future research.

Furthermore, it would be extremely interesting to compare a specific teacher's MA to the MA of their students. Moreover, study between different learner groups could produce more specific information about learner MA. This study was directed at GE and VET teachers. The MA and the support for MA of teachers in early childhood education and elementary school could be studied using the validated inventories in this dissertation. However, the measurements would possibly need modifications and it would have to be re-examined in a new study.

This dissertation examined perceived individual MA and support for MA. In addition to individual studying, many schools employ teamworking exercises (Lasker, Weiss & Miller, 2001). It would therefore be important to examine how teachers support their learners' co-regulative aspects of MA such as Socially Shared Metacognitive Regulation (SSMR). There have been a few attempts to measure co-regulation with questionnaires (De Backer, Kollar, Williams, Seufert, Weinberger, Melzner & Hämäläinen, 2018). As SSMR is quite a new study branch in the field of metacognition, self-report inventories for measuring it presumably do not exist. However, Iiskala (2015) has developed a new on-line research method to study SSMR. It is possible that SSMR could be studied more thoroughly by using both on-line and off-line methods together. Using the ITEMS questionnaire as the basis for developing a new instrument for measuring teacher support for SSMR could be the starting point for such a study.

The data for Study III was gathered just before educational reforms in VET and GE came into effect in Finland. Therefore, there is great potential for a post-transition follow-up data gathering. It would be very interesting to see how the reforms have reflected on student MA and teachers' support of MA. Furthermore, as the ITEMS questionnaire has been translated into other Nordic languages, the project could be broadened into an international scope within Nordic countries.

The responsibility of learners for their own learning has been explicitly brought up many times. However, before a single learner is able to bear this responsibility, they must become metacognitively aware of their learning. In order to do that, they need a teacher to support the development of their MA. Supporting learner MA requires a lot of effort on the teachers' part. Teacher support can be allegorized by imagining both the teacher and the student on a canoe, both looking ahead. The student sits in the front of the canoe, directing it towards a destination of their own, while the teacher's role is to make sure that the boat does not go adrift or lose its way. In order to successfully navigate the canoe, the teacher needs to have an understanding of how to instruct the student to find the optimal channel back to shore and what individual paddling techniques to apply in different situations. Therefore, the journey of learning is mutual, leading to a harbor of the learner's choosing, with support from the teacher.

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