Åbo Akademi University

Johan Korhonen

Learning difficulties, academic well-being and educational pathways among adolescent students

Learning difficulties, academic well-being and educational pathways among adolescent students

Johan Korhonen

Special Education
Faculty of Education and Welfare Studies
Åbo Akademi University
Vasa, Finland, 2016

Custos
Docent Karin Linnanmäki, Åbo Akademi University

Supervisors
Docent Karin Linnanmäki, Åbo Akademi University
Professor Pirjo Aunio, University of Helsinki

Pre-examiners
Professor Markku Niemivirta, University of Helsinki
Professor Ulf Träff, Linköping University, Sweden

Opponent
Professor Rauno Parrila, University of Alberta, Canada

ISBN 978-952-12-3463-7 (Print)
ISBN 978-952-12-3464-4 (PDF)
Painosalama Oy – Turku, Finland 2016

Abstract

The purpose of this thesis was to investigate the interplay between learning difficulties in mathematics and reading, academic well-being and educational pathways. Particular emphasis was placed on mathematical learning difficulties, that was the main interest of research in all four studies. In Study I, the relations between mathematics performance and different language skills (word-, reading comprehension, and spelling) were investigated in ninth-grade students (N = 810). Study II focused on the relative importance of mathematics and reading achievement on students' (N = 1152) educational aspirations together with interest and well-being measures. Study III investigated change and stability of mathematical learning difficulties and academic well-being across the transition to upper secondary education in adolescent students (N = 980). Finally, educational dropout was predicted with learning difficulties and academic well-being in Study IV.

Structural equation modelling techniques were used in all the studies and resulted in the following findings. Students' reading skills were strongly related to their mathematics performance while spelling was not (Study I). Latent profile analysis identified a group of students with combined difficulties in mathematics and reading but no "single difficulty" groups (Study IV). Mathematics was more important compared to reading for boys' educational aspirations, while for girls reading was more important (Study II). School burnout predicted educational aspirations indirectly through interest while academic self-concept had a positive direct effect on students' educational aspirations (Study II). Students with mathematical learning difficulties and low-achieving students did not differ from their peers in academic self-concept development from grade nine to upper secondary education although they experienced lower levels of academic self-concept in grade nine (Study III). However, students with mathematical learning difficulties in general upper secondary education displayed opposite change patterns in school burnout compared to typically achieving students. Both learning difficulties and academic well-being predicted educational dropout (Study IV). In general, learning difficulties and academic well-being were related (Study II, III, & IV) but a group of students with average performance in reading and mathematics, but negative academic well-being was identified (Study IV).

To conclude, learning difficulties and academic well-being are related and both shape students' educational pathways. Moreover, mathematical learning difficulties co-occur frequently with difficulties in reading in this age group. These findings emphasize the importance to identify individual differences not only in students' academic achievement, but also concerning their well-being, and support both areas in school.

Keywords: dropout, educational pathways, learning difficulties, well-being

Abstrakt

Syftet med denna avhandling var att undersöka sambandet mellan inlärningssvårigheter i matematik och läsning, akademiskt välbefinnande och utbildningsvägar. Inlärningssvårigheter i matematik var i fokus i alla fyra delstudier. I studie I undersöktes samband mellan matematikprestationer och olika färdigheter inom läsning (ord-, läsförståelse och stavning) i ett sampel av elever i årskurs nio (N = 810). Studie II fokuserade på den relativa betydelsen av matematik- och läsfärdigheter för studerandes (N = 1152)) utbildningsmålsättningar tillsammans med mått på deras intresse och välbefinnande. I studie III undersöktes förändring och stabilitet av inlärningssvårigheter i matematik och akademiskt välbefinnande hos studerande (N = 980) under övergången till andra stadiets utbildning. Slutligen predicerades skolavbrott i andra stadiet med hjälp av inlärningssvårigheter och akademiskt välbefinnande i studie IV.

Strukturekvationsmodeller användes i alla delstudier och resulterade i följande fynd. Studerandes läsfärdigheter hade ett starkt samband med deras matematikfärdigheter medan deras stavningsfärdigheter inte var relaterade till deras matematikfärdigheter (Studie I). Latenta profilanalyser identifierade en grupp studerande med svårigheter i både läsning och matematik medan ”en-svårighetsgrupper” inte identifierades (Studie IV). Matematikfärdigheter var viktigare för pojkarnas utbildningsmålsättningar medan läsfärdigheter var viktigare för flickornas utbildningsmålsättningar (Studie II). Skoltrötthet hade en negativ indirekt effekt på studerandes utbildningsmålsättningar via intresse medan akademisk självuppfattning hade en positiv direkt effekt (Studie II). Studerande med inlärningssvårigheter i matematik och studerande med svaga prestationer i matematik skiljde sig inte från sina klasskamrater med avseende på utvecklingen av deras akademisk självuppfattning från årskurs nio till andra stadiet även om de uppvisade lägre akademisk självuppfattning i årskurs nio (Studie III). Däremot uppvisade studerande med inlärningssvårigheter i matematik i gymnasiet ett motsatt mönster beträffande utvecklingen av skoltrötthet jämfört med normalpresterande studerande. Både inlärningssvårigheter och akademiskt välbefinnande predicerade skolavbrott (Studie IV). Överlag fanns det ett negativt samband mellan inlärningssvårigheter och akademiskt välbefinnande (Studie II, III, & IV), men också en grupp studerande med medelprestationer och negativt akademiskt välbefinnande kunde identifieras (Studie IV).

Sammanfattningsvis kan man konstatera att det finns ett samband mellan inlärningssvårigheter och akademiskt välbefinnande och att båda formar studerandes utbildningsvägar. Vidare kan man konstatera att inlärningssvårigheter i matematik sammanfaller ofta med inlärningssvårigheter i läsning i denna åldersgrupp. Dessa fynd understryker vikten av att inte endast identifiera individuella skillnader i skolprestationer utan också i akademiskt välbefinnande och stöda båda områden i skolan.

Sökord: skolavbrott, utbildningsvägar, inlärningssvårigheter, välbefinnande

Acknowledgements

This long adventure, finally culminating in this thesis, would not have been possible to finish without the support of many people. Contrary to some beliefs, research is not something you do alone but in cooperation with others. You need a lot of support and guidance, from your colleagues but also from your family and friends. I have been lucky in both departments.

I wish to thank my supervisor Docent Karin Linnanmäki for igniting my interest in mathematical learning difficulties and encouraging me to start this adventure. During our time as colleagues, both in different research projects and at the department, she has always guided me in the right direction but at the same time also given me the freedom to shape my own path. I am also very grateful that she introduced me to my second supervisor Professor Pirjo Aunio. I would not be the researcher I am today without Pirjo. From the very beginning she has challenged me to work harder, aspire higher, and of course, do better research. I am extremely lucky that I have had two great supervisors that complement each other and who both also have become good friends to me.

I would sincerely like to thank my pre-examiners, Professor Markku Niemivirta and Professor Ulf Träff for their constructive feedback on my thesis. I also feel honored to have Professor Rauno Parrila as my opponent.

During this time, I have also had the pleasure to share the ups and downs of doing research with the other members of Pirjos research group; Riikka Mononen, Heidi Hellstrand, Ulrika Ekstam, Eija Väisänen, Henrik Husberg and Anna Tapola. Thank you for taking the time to read and comment all manuscript drafts during the years and for all the fun times during seminars and conferences. I also want to express my gratitude for having Anna as a coauthor in one of the studies. Your critical thinking and knowledge in motivational theories made all the difference. My thanks also go to my colleagues at Åbo Akademi University (Kristina Ström, Christel Sundqvist, Kajsa Lindström, Anki Risberg, and Tanja Östman) for all the peer-support and encouraging words during the years. I would also like to thank my fellow PhD student in the project, Camilla Svens-Liavåg for all the nice discussions about research and other topics. Pekka Räsänen

(Niilo Mäki Institute), thank you for all the inspiring discussions concerning mathematical learning difficulties and for good company during conferences.

I want to express my gratitude to Svenska Kulturfonden, Harry Schaumans stiftelse and Högskolestiftelsen for supporting our project financially.

My well-being during this project has been greatly enhanced by my dear friends. Franken, thank you for being such a great friend since preschool. I also want to express my joy of having the support and company of Ale and Hencki throughout my later educational career, first as classmates in general upper secondary, and then as roommates during our University studies.

Finally, I want to express my gratitude to my family. I grew up in a big and loving family where my parents Solveig and Hannu always put us children first. Thank you for all the love and support. My dear brothers, Mikael, Patrik and Tomi have always been entertaining company and good friends. I also feel very lucky to have a loving person beside me who has supported me during this adventure. Thank you Maria for being there. Our three children have all come to us during this project and have made all things so much more fun. Thank you Alma, Ella and Isak for being you.

Vasa, October, 2016

Johan Korhonen

Table of Contents

List of Original Publications

Study I: Korhonen, J., Linnanmäki, K., & Aunio, P. (2012*).* Language and mathematical performance: A comparison of lower secondary school students with different level of mathematical skills. *Scandinavian Journal of Educational Research, 56*(3), 333-344.

Study II: Korhonen, J., Tapola, A., Linnanmäki, K., & Aunio, P. (2016). Gendered pathways to educational aspirations: The role of achievement, academic self-concept, interest, and school burnout. *Learning and Instruction, 46*, 21-33.

Study III: Korhonen, J., Linnanmäki, K., & Aunio, P. (submitted). Change and stability in mathematical learning difficulties and academic well-being in adolescent students.

Study IV: Korhonen, J., Linnanmäki, K., & Aunio, P. (2014). Learning difficulties, academic well-being and educational dropout: A person-centered approach. *Learning and Individual Differences, 31*, 1-10.

Author contribution

Johan Korhonen is the first author for all four manuscripts that are included in this doctoral thesis. Korhonen is responsible for all the analyses used in this dissertation study and has written all manuscripts under the supervision of Docent Karin Linnanmäki and Professor Pirjo Aunio.

1. Introduction

The effectiveness of a given educational system can be determined based on its capability to equip its students with the relevant academic competencies as well as its support of their general well-being and motivation to learn. In addition, the quality—and especially equality—of an educational system can be measured in terms of its effectiveness in promoting the progress of each individual student irrespective of factors that might serve as disadvantages along the student's educational journey (e.g., the student's social or ethnic background or learning difficulties [LDs]).

This work investigates the impact and interrelationships of LDs and academic well-being on students' educational pathways, as assessed at the end of their compulsory education. This work advances the current knowledge on the relationship between reading difficulties (RDs) and mathematical learning difficulties (MLDs), their impact on educational aspirations and likelihood of dropout along with academic well-being and any changes and/or stability of MLDs and academic well-being in adolescent students across the transition to upper secondary school.

1.1. Learning Difficulties

In this study the focus is on learning difficulties in mathematics and reading. These difficulties are first described separately and then together to provide an overview of what we know of the co-occurrence of LDs in these two content areas.

1.1.1. Learning difficulties in mathematics

Learning difficulties in mathematics can take various forms (e.g., difficulties in basic arithmetic and word problem solving) and have different underlying causes (Toll, Kroesbergen, & Van Luit, 2016; Träff, 2013). Furthermore, the literature uses different terminology—such as mathematical disability (MD), developmental dyscalculia (DD), mathematical learning difficulties (MLD) and low achievement (LA) in mathematics—to describe the mathematics-related LDs

found in an average student population (for a more detailed discussion, see Mazzocco, 2007). Mathematical disability, developmental dyscalculia and mathematical learning difficulties (which are terms that are often used interchangeably) in children have a prevalence of 3% to 6% in the school-aged population, which is comparable to the rate of dyslexia (Shalev, 2007; Rubinstein & Henrik, 2009). This deficit can be tracked to the neural level, where it is manifested in weaker brain activation in the intraparietal sulcus and the middle and inferior frontal gyrus of both hemispheres (Kaufmann, Wood, Rubinstein, & Henrik, 2011; Price et al., 2007; Rotzer et al., 2009). Thus, these conditions have a biological cause.

According the latest knowledge, a defining feature of MLD is difficulty processing numerical information (De Smedt & Gilmore, 2011; Skagerlund & Träff, 2014). More specifically, two possible and potentially related causes—deficits in the approximate number system (ANS) (Mazzocco et al., 2011; Olsson, Östergren, & Träff, 2016) and with symbolic numerical magnitude processing (De Smedt & Gilmore, 2011; Skagerlund & Träff, 2014)—have been reported to characterize MLD. ANS refers to an innate preverbal ability to represent and manipulate quantities and is believed to form the basis for the acquisition of the symbolic number system used to learn formal arithmetic (Dehaene, 2011; Piazza, 2010). Symbolic numerical magnitude processing is usually assessed with a symbolic numerical magnitude comparison task (De Smedt, Noël, Gilmore, & Ansari 2013), where one is instructed to indicate the numerically larger of two presented magnitudes in a symbolic format (i.e., Arabic digits).

A recent meta-analysis incorporating 284 effect sizes from 17,201 participants showed that symbolic numerical magnitude processing is more strongly related to mathematical achievement than nonsymbolic comparisons (Schneider et al., 2016). Moreover, symbolic magnitude processing has been found to be the strongest predictor of arithmetic skills at the beginning of primary school (Lyons, Price, Vaessen, Blomert, & Ansari, 2014), to mediate the relationship between informal and formal mathematics skills (Merkley & Ansari, 2016) and to predict mathematical skills more strongly than phonological awareness predicts reading skills (Vanbinst, Ansari, Ghesquiere, & De Smedt, 2016). Symbolic numerical magnitude processing has also been shown to be related to developmental

dyscalculia (Meijas, Grégoire, & Noël, 2012) and mathematics achievement in adults (Linsen, Torbeyns, Verschaffel, Reynvoet, & De Smedt, 2016).

On a behavioural level, this manifests in difficulties with basic arithmetic tasks. Specifically, children with MLD rely on counting-based strategies when solving arithmetic problems and do not easily shift to more effective strategies like fact retrieval from their long-term memory. To identify students with MLD in both research settings and in practice, some researchers have advocated for the use of the persistence criterion (Fletcher et al., 2005; Stock, Desoete, & Roeyers, 2010; Mazzocco & Räsänen, 2013). For example, to determine the persistence of MLD in a student, he or she has to score under a given cut-off score on a mathematics test for 2 or more consecutive years. Research findings have emphasised the validity of this approach, as there are students who only meet the criteria for MLD at one time point instead of two or more; this is also in line with the response to intervention practices for defining MLDs (e.g., Fuchs et al., 2007).

However, not all children struggling with mathematics meet the criteria for having an MLD. In research settings, it is common practice to identify students with mathematics-related LDs by using a cut-off criteria of up to 35%. Low-achievement (LA) in mathematics has a wider definition than MLD and includes all students who struggle in mathematics for various reasons, including sociocultural and educational factors (Mazzocco, 2007). In addition, working memory (WM) (Friso-van den Bos, Van der Ven, Kroesbergen, & Van Luit, 2013), language skills (Lefevre et al., 2010), motivation (Murayama, Pekrun, Lichtenfeld, & vom Hofe, 2012), self-concept (Seaton et al., 2014) and socioeconomic background (Sirin, 2005) have all been shown to influence students' mathematics skills. Therefore, it is important to distinguish between students with MLD and LA students to accurately advance the knowledge base on why students struggle with mathematics and to determine the best indicators of these difficulties (Mazzocco & Räsänen, 2013.

1.1.2. Learning difficulties in reading

Similar to mathematics, reading difficulties (RDs) can take various forms (e.g., fluency and/or comprehension) and have multiple underlying causes. It has become conventional to distinguish children who have specific RDs (e.g.,

developmental dyslexia) from children who have RDs in the context of more general learning problems (Snowling, 2005). Specifically, an RD or developmental dyslexia is a mild hereditary neurological disorder that manifests as a persistent difficulty in learning to read in children with otherwise normal intellectual functioning and educational opportunities (Ramus, 2004). More specifically, students with RD tend to have pervasive deficiencies in word identification, fluency, phonological (letter sound) decoding, and spelling (Vellutino & Fletcher, 2007). The prevalence of specific reading difficulties depends on the specific cut-off point taken as indicative of RD, but studies have shown that 3% to 10 % of the population has RD (Snowling, 2000).

On a neural level, when comparing people with RD and normal readers, studies have shown that there is difference between brain structure and function, particularly in the left hemisphere temporal regions (Shaywitz et al., 2002).Well-established markers for RD at the cognitive level are phonological processing deficits (Vellutino, Fletcher, Snowling, & Scanlon, 2004) and deficits in rapid automatized naming (RAN) (Kirby, Georgiou, Martinussen, & Parrila, 2010; Landerl et al., 2013). Furthermore, the associations among phonological processing, RAN and reading skills are moderated by the orthographic complexity of the language under study (e.g., Finnish versus English) (Georgiou, Torppa, Manolitsis, Lyytinen, & Parrila, 2013). As stated earlier, not all students who are struggling in reading show these domain-specific cognitive deficits and should not be categorized as having an RD. This broader group, which encompasses all students with difficulties in reading regardless of the underlying cause, is usually defined as low-achieving students in reading. In this group, problems in reading may arise from factors like WM (Daneman & Carpenter, 1980), motivation (Guthrie et al., 2007), self-concept (Retelsdorf, Köller, & Möller, 2014) and socioeconomic background (Sirin, 2005).

1.1.3. Learning difficulties in both mathematics and reading

Many students have problems in attaining average achievement in both reading and mathematics (Dirks, Spyer, van Lieshoult, & de Sonneville, 2008; Light & DeFries, 1995). This rate of co-occurrence is substantially greater than would be predicted from the individual prevalence rates of MLDs and RDs (Dirks et al.,

2008). Students with comorbid difficulties display more severe and global functional difficulties than students with only MLDs (Andersson & Lyxell, 2007; Fuchs & Fuchs, 2002; Mazzocco & Myers, 2003). These students also seem to have broader problems with language learning, especially with spelling and reading comprehension, than children with only one of these difficulties (Dirks et al., 2008). For example, both Ostad (1998) and Shafrir and Siegel (1994) have reported an overlap between spelling problems and MLDs.

Based on the literature, there is no shared understanding for the origins of the comorbidity of RD and MLDs. One possible cause of this co-occurrence on the cognitive level is working memory capacity (Hanich, Jordan, Kaplan, & Dick, 2001; Siegel & Ryan, 1989). Research findings suggest that students with low-achievement in mathematics have a general working memory processing deficit; thus, this could partially explain the shared variance in mathematical skills and language skills (Kyttälä, 2008; Pickering & Gathercole, 2004). However, Landerl, Fussenegger, Moll and Willburger (2009) found two different cognitive profiles for children with dyscalculia and dyslexia, namely a phonological deficit in dyslexia and a number-processing deficit in the case of dyscalculia. Their conclusion concerning children with comorbid difficulties is that they have additive cognitive deficits that indicate no evidence for shared cognitive risk factors. There are other findings that suggest that the presence of both RDs and MLDs seems to be caused by a fundamental deficit in phonological processing, which affects, for instance, arithmetic fact retrieval (Geary, 1993; Geary & Hoard, 2001; Rourke & Conway, 1997).

However, dysfunction in phonological processing does not seem to be a plausible explanation, as approximately half of the children with MLDs do not have RDs (Badin, 1983; Ostad, 1998), nor is it clear why these students also show fact retrieval deficits while their phonetic abilities are intact (Jordan, Hanich, & Kaplan, 2003). Augustyniak, Murphy and Phillips (2005) have concluded that mathematical ability seems to be based on a more complex set of abilities than reading ability. Furthermore, findings show that some areas in mathematics are more dependent on reading abilities than others (Jordan et al., 2003; Vukovic & Lesaux, 2013a).

The measures used to operationalize reading skills also vary among studies. Measures such as word decoding, rapid naming, spelling and reading comprehension are often used to operationalize reading skills, and in many studies, composite scores consisting of two or more of these measures are used to examine the relationship between mathematics and reading (Dirks et al., 2008; Swanson & Beebe-Frankenberger, 2004; Wise et al., 2008). Only a few studies have examined the unique contribution of different language skills to mathematics performance (Vukovic & Lesaux, 2013b). Dirks and colleagues (2008) have demonstrated that using different measures of reading skills results in different children being identified as having RDs and, thus, different children being treated as having both RDs and MLDs. So far, it seems that there is no consensus of the underlying causes for RDs and MLDs and why these difficulties sometimes overlap each other.

The terminology and definitions for RD and MLD vary across studies, although a common factor visible in school practice is that students struggling with reading and mathematics learning can most often be found in the lowest performing group on standardized mathematics and reading tests. A traditional and widely used approach to define subtypes of learning difficulties is to divide students into groups according to RD only, MLD only and combined difficulties (MLDRD) (Anderson & Lyxell, 2007; Andersson, 2010; Jordan et al., 2003; Vukovic, Lesaux, & Siegel, 2010). Interestingly, the MLD-only and RD-only groups have been found to perform at the same level on word problem tasks and significantly better than the MLDRD group (Jordan et al., 2003).

Consistent with these results, Vukovic and colleagues (2010) have demonstrated that both children with dyslexia and children with specific reading comprehension difficulties performed equally on word problems and significantly poorer than normal readers. However, the children with reading comprehension difficulties did not differ from normal readers in arithmetic fact fluency and operations, whereas the dyslexia group performed on a lower level. They concluded that children with decoding problems (dyslexia) had a higher risk of also experiencing MLD. Concerning MLD, there is evidence that both the MLD-only and MLDRD groups showed fundamental deficits in factual

knowledge and that this is a primary characteristic for MLDs (Andersson, 2010; Jordan et al., 2003).

A recent meta-analysis by Swanson, Jerman and Zheng (2009) investigated differences in cognitive features in students with MLDs, typically achieving students, RD students and MLDRD students. The clearest differences were found between the typically achieving students and those with MLD, namely in working memory and literacy skills, whereas the MLD and RD groups differed in variation in working memory and mathematical problem-solving skills. The only thing that differentiated the MLD students from MLDRD students was IQ and long-term memory, with the MLDRD group displaying lower levels for both.

These results lend support to the hypothesis that grouping that aims to create qualitatively (type) different subtypes only creates quantitatively (level) different subtypes of learning difficulties. To summarize, we can conclude that in the younger children (aged 7-13), the MLD-only and MLDRD groups performed worse than the RD-only and typically achieving students on the more technical aspects of mathematics (factual knowledge, place value, etc.) and that the children with dyslexia performed poorer compared to the children with reading comprehension and typically achieving children in the more technical aspects of reading (e.g., word reading) (Andersson, 2010; Jordan, et al., 2003; Vukovic et al., 2010). However, the MLDRD group seemed to perform on a lower level on almost all measures compared to the other groups, and the RD-only and MLD-only groups performed at the same level on mathematical word problem tasks. It is therefore tempting to look at both mathematical and reading skills as continuums where the order of the traditional subtypes of learning difficulties is similar; i.e., the MLDRD group is at the lower end and the typically achieving children are at the higher end of the continuum. The MLD-only and RD-only groups fall between and their order are defined by which skill is currently assessed.

1.2. Academic Well-Being

School is a central factor in the lives of adolescents (Eccles & Roeser, 2009), and therefore it is important to define well-being in relation to the school context.

How students perceive themselves as learners in school and how they experience their schooling have been shown to influence their well-being (Goetz, Cronjaeger, Frenzel, Ludtke, & Hall, 2010; Tuominen-Soini, Salmela-Aro, & Niemivirta, 2008, 2012). Furthermore, students' academic well-being is viewed as an important indicator of the educational process (van Petegem, Aelterman, Rossel, & Creemers, 2007) and has received growing attention in recent years (Holopainen, Lappalainen, Junttila, & Savolainen, 2012; Rueger, Malecki, & Demaray, 2010; Tuominen-Soini et al., 2008, 2012). However, there is no consensus around the definition or measurements of academic well-being, so positive and negative indicators of well-being, such as self-esteem, school value and stress, are commonly used as indicators of adolescent academic well-being (Pollard & Lee, 2003). In the present study, academic well-being is operationalized with academic self-concept, school burnout, and perceived learning difficulties.

1.2.1. Academic self-concept

Self-concept is theorised as a hierarchical multidimensional construct (Shavelson, Hubner, & Stanton, 1976; Marsh & Shavelson, 1985). The most relevant dimension of self-concept in the educational settings is arguably academic self-concept. Academic self-concept can be defined as mental representations of one's competencies in academic domains (Marsh & Craven, 1997). These ability beliefs are influenced by prior achievement and social comparison processes (Marsh, 1986). Academic self-concept is positively related to achievement (Marsh, Hau, & Kong, 2002; Valentine, DuBois, & Cooper, 2004), approaches to learning (Burnett, Pillay, & Dart, 2003), social interaction (Gurney, 1986) and general happiness (Harter, 1990). According to the OECD, self-concept and related constructs are "closely tied to students' economic success and long-term health and wellbeing" (2003, p. 9).

1.2.2. School burnout

School burnout can be defined as exhaustion due to school demands, a cynical and detached attitude toward one's school and feelings of inadequacy as a student; it can develop as a result of a high imbalance between perceived

demands and personal resources (Salmela-Aro, Kiuru, Leskinen, & Nurmi, 2009; Salmela-Aro & Upadyaya, 2014a). These subdimensions have been shown to be associated with adolescent students' motivational strivings, whereby a tendency to minimize schoolwork and effort (i.e., work avoidance orientation) increases the likelihood of cynicism and sense of inadequacy. It is noteworthy that even high-achieving and motivated students, especially girls, have been found to be vulnerable to exhaustion (Tuominen-Soini et al., 2012; Tuominen-Soini & Salmela-Aro, 2014). Furthermore, previous studies have found that girls experience higher levels of school burnout than boys (Salmela-Aro, Kiuru, & Nurmi, 2008; Salmela-Aro & Tynkkynen, 2012). School burnout is also related to low academic achievement (Kiuru, Aunola, Nurmi, Leskinen, & Savolainen, 2008) and depression (Bakker et al., 2000; Salmela-Aro, Savolainen, & Holopainen, 2009).

1.2.3. Perceived learning difficulties

Perceived learning difficulties have not received much attention in the literature. Theoretically, perceived learning difficulties are different from academic self-concept and more related to self-efficacy (Bong & Skaalvik, 2002). While self-concept refers to an individual's' general perceptions of the self in a given domain, self-efficacy refers to the expectations and convictions of what the individual can accomplish in a given situation. Perceived learning difficulties refer to difficulties with learning in a particular situation or setting (e.g., difficulty taking notes when the teacher explains specific content in class). In the few studies incorporating perceived learning difficulties, it has been shown to be related to academic well-being, academic achievement and secondary education placement (DeGarmo & Martinez, 2006; Hakkarainen, Savolainen, & Holopainen, 2012).

1.3. Educational Pathways

To better understand the relationship between learning difficulties and academic well-being, it is useful to take into the consideration the context that this relationship is formed in. Adolescent students are generally in the middle of their

educational journey, making it a natural point to start investigating the relationship between learning difficulties and academic well-being in conjunction with their educational aspirations, transition to upper secondary school and possibly dropping out of school. The various processes leading to these important educational outcomes have been described and explained using several prominent theories incorporating achievement and motivational beliefs (Eccles et al., 1983; Marsh, 1986, 1987). In the following sections, the adolescent educational pathway and the processes influencing it are described, and the variables under study (i.e., learning difficulties and academic well-being) are situated within the theories used to explain these processes.

1.3.1. Educational aspirations

Educational aspirations in adolescence have been used to explain educational disparities in general and individuals' occupational choices and attainment later in life (Domina et al., 2011; Rojewski, 2005). There is no commonly shared definition for the term 'educational aspirations', but it is often used to refer to a person's goals and plans within an academic setting (Trebbels, 2015). Researchers have defined and measured educational aspirations via the number of career plans per adolescent (Mendez & Crawford, 2002), the prestige of their educational aspirations (Leung, Conoley, & Scheel, 1994; Viljaranta, Nurmi, Aunola, & Salmela-Aro, 2009) and the level of self-set educational goals (Vasalampi, Salmela-Aro, & Nurmi, 2009; Watt et al., 2012).

Educational aspirations can also be defined as being either idealistic or realistic. While idealistic aspirations refer to the attainment level that a student hopes to achieve, realistic aspirations reflect the actual perceived likelihood of success and more pragmatic expectations of completing a certain level of education (Rojewski, 2005). However, in several studies focusing on educational choices, the operationalisation of educational aspirations has covered both idealistic and realistic alternatives, with no clear distinction being made between the two terms Chow, Eccles, & Salmela-Aro, 2012; Durik, Vida, & Eccles, 2006; Guo, Marsh, Parker, Morin, & Yeung, 2015). In some studies, girls have reported higher educational aspirations (Mahaffy & Ward, 2002; Mau & Bikos, 2000), whereas in other studies, boys' aspirations have been higher (Inoue, 1999;

Mendez & Crawford, 2002). There have also been studies that found no gender differences in educational aspirations (e.g., Ireson & Hallam, 2009; Watt et al., 2012). Besides the possible gender differences in the level of educational aspiration, it also seems that the processes or paths that lead to these aspirations may differ by gender (Domene, Shapka, & Keating, 2006; Watt et al., 2012).

1.3.1.1. Expectancy-value theory

Students' abilities and academic success (both in reading and mathematics) shape their educational aspirations (Durik et al., 2006; Shapka, Domene, & Keating, 2006). However, academic achievement is not, by itself, a sufficient factor to explain students' educational aspirations. For example, irrespective of girls' high mathematics and sciences grades, they are underrepresented in advance STEM courses and occupational fields. Further, it has been documented that along with the possible direct effects, the influence of academic achievement may be indirect and mediated by different motivational constructs (Parker, Nagy, Trautwein, & Lüdtke, 2014).

According to the expectancy-value model (Eccles et al., 1983; Wigfield & Eccles, 1992), students' expectancies of success at school and subjective task values are key predictors of academic decision making that are related but distinct. Expectancies of educational success are defined as an individual's competence perceptions about how well they will perform on future academic tasks and subjective ability beliefs (Eccles et al., 1983).

In many of the studies, students' competence perceptions have been conceptualized through academic self-concept. Subjective task value is usually operationalized in terms of intrinsic value (i.e., interest) and importance value (i.e., utility and attainment value combined) (Jacobs et al., 2002; Watt et al., 2012). Individual interest refers to the tendency to reengage and enjoy a particular content domain (Frentzel, Goetz, Pekrun, & Watt, 2010; Renninger & Hidi, 2011). Individual interest towards an academic domain is likely to develop when engagement with it is experienced as inherently rewarding (Renninger & Su, 2012). Once interest deepens, it becomes intertwined with a student's personal values and may even form a part of their identity (Renninger, 2009: Renninger & Hidi, 2011). Both academic self-concept and individual interest

have been shown to positively predict educational aspirations in a number of studies (Guo, Marsh, Morin, Parker, & Kaur, 2015; Guo, Marsh, Parker, Morin, & Yeung, 2015; Watt et al., 2012).

Within the expectancy-value framework, some studies have also examined how self-perceived drawbacks predict educational choices (Perez, Comley, & Kaplan., 2014). The concept of cost has been utilized to describe the perceived negative consequences of engaging in learning, such as required effort or psychological well-being (for a more detailed discussion, see Eccles et al., 1983). In addition, these studies have identified that cost measures both predict and correlate negatively with student interests (Flake, Barron, Hulleman, McCoach, & Welsh, 2015; Gaspard et al., 2014) and educational aspirations (Battle & Wigfield, 2003; Luttrell et al., 2010; Perez et al., 2014). In fact, the conceptualisations of cost and school burnout share some common features. For example, the exhaustion component of school burnout is related to both dimensions of cost, namely, the amount of effort and emotional and psychological demands, whereas inadequacy and cynicism are more similar to the latter dimension (Flake et al., 2015; Gaspard et al., 2014; Salmela-Aro, Kiuru et al., 2009).

However, there are also some important differences between school burnout and cost. First, school burnout is a more general negative emotion toward school (Salmela-Aro, Savolainen, & Holopainen, 2009), whereas cost is more domain or situation specific (Wigfield & Eccles, 2000). Second, school burnout develops over a longer period of time, whereas cost is more situational and anticipatory. In fact, arguably, school burnout can be regarded as a consequence of experiencing prolonged cost (Shaufeli & Bakker, 2004; Tuominen-Soini et al., 2008). To summarize, despite the differences between cost and burnout, both have been theorized and shown to hinder student motivation and engagement by using up their psychological resources and decreasing their positive affect (Barron & Hulleman, 2015; Salmela-Aro & Upadyaya, 2014a; Tuominen-Soini & Salmela-Aro, 2014). As a consequence, students' capability and desire to set and achieve ambitious educational goals may also be diminished (Nurmi & Salmela-Aro, 2002).

1.3.1.2. Internal/external frame of reference model

The internal/external (I/E) frame of reference model (Marsh, 1986; Marsh et al., 2015) postulates that students' self-perceptions are dependent not only on social (external) comparisons, but also on dimensional (internal) comparisons, in which achievement in one school subject is evaluated in reference to another school subject (Möller et al., 2009). Traditionally, this model has been used to explain the relationship among mathematics, verbal achievement and self-concept. In the external comparison process, high mathematics achievement is supposed to lead to higher mathematics self-concept and high verbal achievement is supposed to lead to higher verbal self-concept. However, according to the internal comparison process, higher mathematics achievement will result in lower verbal self-concept after the effect of verbal achievement is taken into account. Consequently, while students achieving well in mathematics also often perform well in reading, they consider themselves 'as being good at' mainly one or the other of the domains. There are robust findings across age groups, gender and countries concerning the presence of this mechanism (Möller, Pohlmann, Köller, & Marsh, 2009).

The I/E frame of reference model has been extended to the expectancy-value model (Eccles, 2009). According to Eccles (2009), the external and internal comparisons of one's abilities and values are a natural part of adolescents' identity development process, whereby they start to identify themselves more strongly with some academic domains than with others. This identification process, in turn, is likely to be influenced by gender stereotypes: out of two academic domains that an adolescent achieves well in, he or she will be more prone to emphasize and prefer the one that corresponds to gender-typical expectations and norms. As a consequence, adolescents' academic choice behaviour and expectations concerning their educational and occupational goals may also be influenced (e.g., Nagy, Trautwein, Baumert, Köller, & Garrett, 2006; Parker et al., 2012).

1.3.1.3. Gendered pathways to educational aspirations

In this study, one focus have been on the relative importance of reading and mathematics achievement (and well-being measures) for students' educational

aspirations, which can be investigated in the context of the expectancy-value model and the I/E model. Studies focusing solely on one academic domain have found mixed results concerning gender differences in the relationship (i.e., moderator effects) among academic self-concept, individual interest and educational aspirations (e.g., Durik et al., 2006; Watt et al., 2012).

Interestingly, in studies contrasting two or more academic domains, gender has been found to moderate the effects of these variables on educational aspirations and choices. For example, Nagy and colleagues (2006) demonstrated that during secondary school, boys' self-concept and interest in mathematics affected their decision making concerning advanced biology course choices, whereas for girls, the choices in mathematics and biology were independent of the contrasted domain's motivational beliefs.

In line with this, a few studies utilising a person-centred methodological approach have investigated how different interest profiles measured by interest in different domains predict educational aspirations (Chow & Salmela-Aro, 2011; Chow et al., 2012; Viljaranta et al., 2009; Watt, 2005). In these studies, boys were observed to be more likely to have a profile of high interest or task values in mathematics and science compared to girls, who were more likely to display a profile with high reading interest (Chow et al., 2012; Viljaranta et al., 2009).

While in Chow and colleagues' study (2012) the interest profiles fully mediated the relationship between gender and educational aspirations in the physical and information technology–related sciences, Viljaranta and colleagues (2009) found that their task-value profiles predicted educational aspirations for girls but not for boys. They hypothesized that boys´ educational aspirations might originate from an objective criterion (e.g., academic achievement), whereas girls seemed to base their expectations on broader considerations, including their values and motivation.

1.3.2. Transition to upper secondary education

Educational transitions have been found to be related to a decrease in students' motivation and well-being (e.g., Eccles & Midgley, 1989; Otiz, Grouzet, & Pelletier, 2005). So far, most studies have focused on middle school transitions (i.e., junior high school to senior high school) in early adolescence and have been

conducted in the United States. In Finland, the transition from compulsory education to upper secondary education (high school to college) is an important step in adolescent students' educational pathways (Nyyssölä, 2004). More specifically, the general upper secondary schools prepare students for university studies (i.e., the academic track), whereas the vocational upper secondary schools (i.e., the vocational track) are more practically oriented, preparing students for working life. Admittance to the academic track usually requires higher academic skills compared to the vocational track, and it is generally recommended that adolescents move to a school form that is in accordance with their academic skills (Eccles, 1993; Hakkarainen, Holopainen, Savolainen, 2012; Savolainen et al., 2008). It is expected that these students will show higher motivation and well-being when they are in a more congruent educational setting (Vasalampi, Salmela-Aro, & Nurmi, 2010) compared to a compulsory education setting that is the same for all students. However, there is a lack of studies that have specifically looked at changes in well-being among students with learning difficultiess. Studies that have examined the development of school burnout have not specifically looked at students with MLDs; rather, the focus has been on differences in educational tracks and gender (Salmela-Aro, Kiuru, & Nurmi, 2008; Salmela-Aro, Savolainen, & Holopainen, 2009; Salmela-Aro & Tynkkynen, 2012; Salmela-Aro & Upadyaya, 2014b; Tuominen-Soini & Salmela-Aro, 2014).

However, in a study by Salmela-Aro and colleagues (2008), low-achieving students (operationalized by a low grade point average) were identified as having higher levels of school burnout compared to their peers. In addition, girls in both tracks and all students in the academic track reported an increase in school burnout (Salmela-Aro et al., 2008; Salmela-Aro & Tynkkynen, 2012; Salmela-Aro & Upadyaya, 2014b).

1.3.2.1. Academic self-concept and the 'big fish in a little pond' effect

In this study, academic self-concept is also considered to reflect students' academic well-being. In general, academic self-concept development has been found to be related to academic achievement in a reciprocal manner (e.g., Marsh, Hau, & Kong, 2002). However, the educational setting that students are situated in also has an impact on their academic self-concept. The 'big fish in a little pond'

effect (BFLPE) (Marsh, 1987; Marsh & Craven, 2002; Nagengast & Marsh, 2011) can be used to describe the effects of one's frame of reference in educational settings. The BFLPE is based upon a social comparison process (for a detailed account of the theoretical background of the BFLPE, see Marsh et al., 2008), where individual student achievement has a positive effect on academic self-concept while school-average achievement has a negative effect on academic self-concept. Students compare themselves with their peers, and, therefore, individual academic self-concept is shaped not only by a student's own achievement, but also by the achievement of other students in the same class or school. Thus, students have lower academic self-concept when they are in high-ability classes or schools compared to students of the same ability that are educated in mixed or low-ability classes or schools. Interestingly, these kind of effects have also been observed when comparing the academic and vocational track in a sample of Finnish students concerning their education-related goal appraisals (Vasalampi et al., 2010).

Students with MLDs have lower academic self-concept in general compared to their peers (Bear, Minke, & Manning, 2002; Zeleke, 2004). The literature on learning difficulties and the BFLPE is scarce. In the only study conducted with this focus, Marsh, Tracey and Craven (2006) demonstrated that students with learning difficulties in inclusive settings had lower academic self-concept compared to students with learning difficulties in segregated settings and offered the BFLPE as a potential explanation for this result.

1.3.3. School dropout

Dropping out of school can have far-reaching negative consequences on an individual level. Students who drop out are more likely to be unemployed (Sum, Khatiwada, McLaughlin, & Palma, 2009), have a lower income level (Levin, Belfield, Muenning, & Rouse, 2007; Rumberger & Lamb, 2003) and experience lower levels of general well-being (Bynner & Parsons, 2002; Lamb, 2011). In addition to these individual costs, there are also social costs associated with increased welfare needs and reduced taxation revenue (Owens, 2004).

As graduation from secondary school is currently viewed as the minimum level of educational attainment for the successful inclusion of young people into

society, it is important to identify at-risk groups already present in comprehensive education. Converging evidence suggests that the single most important dropout predictor is low academic achievement (Battin-Pearson et al., 2000; Janosz, LeBlanc, Boulerice, & Tremblay, 1997, 2000), which is often related to a lower socioeconomic background of a student's family (Duncan & Brooks-Gunn, 2001; Fall & Roberts, 2012). However, learning difficulties in mathematics and reading have not been analysed separately in these studies on dropout rates. A large body of research has also determined that students classified as having low academic well-being face a higher risk of dropping out of school (Archambault, Janosz, Morizot, & Pagani, 2009; Fall & Roberts, 2012; Fortin, Marcotte, Potvin, Royer, & Joly, 2006; Janosz et al., 1997, 2000).

1.4. The Present Study

Although considerable efforts have been made to understand the dynamics between learning difficulties in reading and mathematics and their relationship to other educational outcomes and well-being measures, there are still gaps in our shared understanding of these processes. Different conceptualizations of the constructs under study, the inclusion of different variables in research designs and different theoretical starting points have made it challenging to integrate findings from different studies. This dissertation study makes an attempt to provide a more holistic picture of adolescent students' educational pathways with focus on learning difficulties in reading and mathematics and academic well-being.

In this study, MLDs are defined as problems in the domain of mathematics that are attributed to either environmental or individual factors. This is a broader definition of MLD than, for example, mathematical disability (Geary, 1994) or developmental dyscalculia (Butterworth, 2005). Similarly, RDs are defined as problems with reading that are attributed to either environmental or individual factors. However, an attempt is made in this study to separate low-achieving students and students with MLDs using the persistence criterion (Fletcher et al., 2005) and to investigate possible differences in the development of academic well-being measures in adolescent students in the low-achieving and MLD

groups. In the present work, academic well-being is operationalized through academic self-concept, perceived learning difficulties and school burnout. Academic well-being is highly relevant for the educational process (Tuominen-Soini et al., 2008, 2012) and is closely related to academic achievement (Hakkarainen et al., 2012; Valentine et al., 2004).

Even though there is extensive evidence on the link between learning difficulties and educational outcomes (e.g., school dropout and educational aspirations), there are research gaps that the present study aims to fill. Firstly, previous studies have more or less treated students with learning difficulties as a homogenous group, which means that there is a lack of knowledge of whether some types of learning difficulties impose a higher risk of dropping out of school or predict an individual's educational aspirations differently.

Secondly, there are varying research results regarding the relationship between reading difficulties and mathematical learning difficulties. Even though much research has been conducted within the framework of the RD, MLD, and MLDRD typologies, results from these same studies support the hypothesis that the differences between the groups are more quantitative than qualitative. Moreover, these studies have not utilized person-centred methods in creating classifications and have not focused on adolescent students. The assessment methods used to measure reading skills also vary between studies. In many studies, composite scores consisting of two or more scales of reading skills (e.g., word reading and reading comprehension) have been used to examine the relationship between mathematics and reading (see, for example, Dirks et al., 2008; Swanson & Beebe-Frankenberger, 2004; Wise et al., 2008). There seems to be a gap in the research literature concerning studies that examine the unique contribution of different reading skills to mathematics performance.

Based on the literature on educational aspirations, which has mostly been situated either within the expectancy-value model or I/E frame of reference model, the variables included in our study play pivotal roles in the processes that shape these aspirations. Furthermore, the literature clearly demonstrates that these processes are somewhat different for boys and girls and that incorporating achievement and motivational beliefs measures from the two domains (mathematics and reading) are warranted. Hence, we have incorporated

individual interest in mathematics and reading into our empirical model as mediators of the effects of mathematics and reading achievement according to the expectancy-value model. Finally, there is some evidence that students' academic well-being should also be included when trying to understand educational aspirations (e.g., Perez et al., 2014).

This dissertation is based on four original publications, which are referred to in the text by Roman numerals (studies I to IV). The overall aim of the present dissertation study was to investigate the interplay among LDs in mathematics and reading, academic well-being and educational pathways (Figure 1) in adolescent students. The general aim was pursued based on the following research questions:

1) How are mathematical learning difficulties (MLD) and reading difficulties (RD) related in adolescent students (studies I and IV)?

2) How are learning difficulties and academic well-being related (studies II, III and IV) in adolescent students?

3) How are changes in academic well-being related to mathematical learning difficulties (MLD) during the transition from comprehensive school to upper secondary school (study III)?

4) How can learning difficulties and academic well-being explain educational aspirations and school dropout in adolescent students (studies II and IV)?

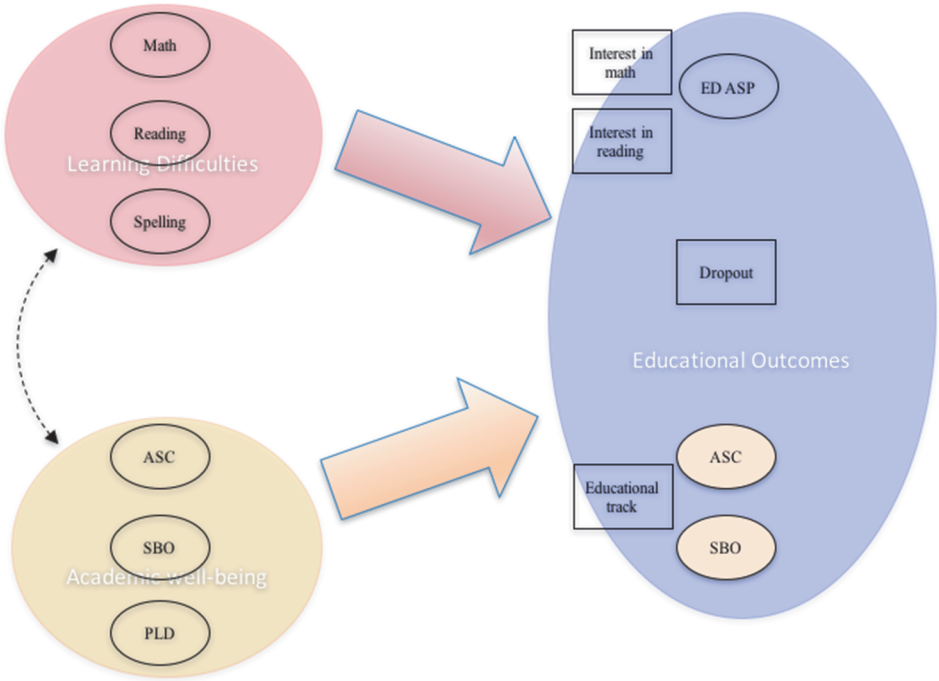

Figure 1. Theoretical model of adolescent students' educational pathways where LDs and academic well-being predict educational outcomes; ASC = academic self-concept, SBO = school burnout, PLD = perceived learning difficulties, ED ASP = educational aspirations, educational track = general or vocational upper secondary education.

1.4.1. Context: The Finnish education system

Finland is officially bilingual, with Finnish and Swedish being the national languages. The Swedish-speaking minority constitutes approximately 5% (n = 291,219) of the population (Official Statistics of Finland, 2012a). The education systems are identical for both language groups but, unusual for a minority, the Swedish-speaking population has lower unemployment rates (Saarela & Finnäs, 2003) and higher general well-being (Nyqvist, Finnäs, Jakobsson, & Koskinen, 2008).

In Finland, comprehensive school is a 9-year compulsory general schooling for all children aged 7 to 16 years. It is comprised of primary school (Grades 1 to 6) and lower secondary school (Grades 7 to 9). At the end of comprehensive school (Grade 9), students choose between upper secondary general education (i.e., the academic track) and vocational education (i.e., the vocational track). A majority of students (50%) who finish compulsory education in Finland choose

upper secondary education, whereas 41% of the students choose vocational education. Upper secondary education prepares students for university studies, whereas vocational education is more practically oriented (for a detailed description, see Rinne & Järvinen, 2011). This choice is one of the most important decisions that they will make regarding the ultimate level of education that they will attain (Nyyssölä, 2004).

When students apply for a secondary education programme, there is a risk that they will not be admitted to an educational program or that they drop out at an early stage if their academic performance is low. Studies have shown that LDs increase the risk of not being admitted to an educational program and that these students tend to choose the vocational education track (Järvinen & Vanttaja, 2006; Savolainen, 2001; Vanttaja & Järvinen, 2004). Students with LDs that get admitted are at a high risk of dropping out and leaving school without finishing their studies, particularly post-compulsory schooling (Jahnukainen, 2001).

The dropout rate at Finnish comprehensive schools is minimal (0.04%; Official Statistics of Finland, 2012b), but in the secondary education programmes, the school dropout rate is far larger (5.5%; Official Statistics of Finland, 2012b). One reason for the high completion of comprehensive education is the extensive special educational support system in Finnish schools (Simola, Rinne, & Kivirauma, 1999). In Finland, on average, children from homes with low socioeconomic status have a higher probability of being excluded from education and beginning their working life between the ages of 16 to 18 than the rest of the population (Järvinen & Vanttaja, 2001). The relationship between parental background and achievement in Finland is also well documented, although this effect is weaker than in many other countries (OECD, 2010).

2. Methods

2.1. Participants and Procedure

In all of the four original studies used in this dissertation, the data were drawn from the Vem Väljer Vad (VVV, 'Who Chooses What') study, which is a project led by Karin Linnanmäki (Åbo Akademi University). The project has been mainly funded by the Swedish Cultural Foundation in Finland and Högskolestiftelsen i Österbotten. VVV is an ongoing follow-up study whose overall aim is to investigate adolescent students' educational pathways from compulsory to tertiary education with a focus on learning difficulties and academic well-being. The project started in 2007, and I have been involved in the planning and implementation of the data collection from the beginning of this study. Data have been collected from 14 different Swedish-speaking secondary schools located all over the geographic area inhabited by the Swedish-speaking minority group in Finland.

The data used in the present work were from two measurement occasions. The first data collection was executed when the students were in Grade 9 in 2008, and the second data collection was conducted 2 years later when the same students were in secondary education. Information on the measures, number of participants and the time points included in the original studies are summarized in Table 1.

Table 1

Measures, number of participants and time points included in the studies

Measure	*N*	Study I	Study II	Study III	Study IV
Time point 1					
Mathematics	980	X	X	X	X
Reading comprehension	1028	X	X		X
Word comprehension	1000	X	X		X
Spelling	1019	X			X
Academic self-concept	866		X	X	X
School burnout	921		X	X	X
Perceived learning difficulties	921				X
Interest in math	870		X		
Interest in reading	1034		X		
Educational aspirations	859		X		
Parental educational background	734				X
Time point 2					
Mathematics	712			X	
Academic self-concept	650			X	
School burnout	693			X	
Upper secondary education track	1066			X	
School dropout	1152				X

2.2. Measures

For this dissertation study, data were collected with assessment tools to measure students' skills in reading and mathematics. Academic well-being was measured with questionnaires, and students were also asked to report gender, parental educational level and educational aspirations. Teachers reported students' interest in mathematics and reading. Information concerning dropout and educational track was gathered from schools.

2.2.1. Mathematics skills

The mathematics skills of students were assessed with the standardized KTLT test (Räsänen & Leino, 2005). We used the Swedish version of the scale, which has been standardized for the Finnish Swedish population. This scale assesses students' performance in basic arithmetic (addition, subtraction, multiplication

and division), word problem solving, algebra, geometry and unit conversion skills. It is also used for screening purposes for identifying at-risk students. This scale is intended for Grades 7 to 9 (13 to 16 years of age), and it consists of four parallel versions (A, B, C and D). The KTLT test contains 40 items, with a correct answer worth 1 point and an incorrect answer worth no points. Thus, the results range from 0 to 40. Students have 40 minutes to complete the scale, which is in the form of a paper-and-pencil test.

2.2.2. Reading skills

The LS reading ability test (Johansson, 2005) is a standardized test for Grades 7 to 9 (13 to 16 years of age) and Grade 1 in upper secondary school (16 to 17 years of age). The test identifies students with RDs. The subtests we used were word comprehension, reading comprehension and a spelling test. The word comprehension and reading comprehension scales had multiple-choice tasks, and in the spelling test, the words that needed to be written were presented verbally for the students.

Word comprehension (40 items). These items measured students' word comprehension skills in Swedish. There were 40 sentences that were missing the last word. Five words were listed after each sentence, and the students had to choose the right word that fit the sentence.

Reading comprehension (5 texts). These items measured students' reading comprehension skills in Swedish. There were five short texts that the students read. After that, they chose the correct title from four suggestions for each text and then chose the correct statements from six statements about the content of the text.

Spelling (50 items). These items measured students' spelling skills in Swedish. The test administrator read a sentence and then repeated words that the students must write down correctly.

2.2.3. Academic self-concept

Academic self-concept was measured using items from the Perceived Competence Scale for Children (Harter, 1982). The original scale consists of 28 items and is a paper-and-pencil test. We used a modified version that had two

additional items, one of which measured academic self-concept. For each item, students were given two statements. First, they were asked to decide if they are more like the young people described on the left side of the statement or more like those depicted on the right side. Secondly, they were asked to mark whether each statement was completely true or just partly true for them. The responses were then scored on a 4-point scale ranging from least competent (1) to most competent (4). Because the original scale was created in English and available in Finnish and Norwegian, we utilised a multilingual team to ensure the validity of the instrument by translating the questionnaire from Norwegian to Swedish and from Finnish to Swedish and comparing the similarity of both translations.

2.2.4. Perceived learning difficulties

Perceived learning difficulties were assessed using nine items measuring how much difficulty the students experienced in their schoolwork (e.g., take notes in class, understand instructions on the whiteboard, etc.). Each item was assessed using a 7-point Likert scale ranging from 1 (not at all) to 7 (very much). The items originally came from the School Health Promotion study (Rimpelä, 2003) and were translated to Swedish for this purpose.

2.2.5. School burnout

School burnout was assessed using the School Burnout Inventory (SBI), which is a nine item scale developed by Salmela-Aro and Näätänen (2005). The inventory consisted of three subscales: exhaustion at school (EXH), cynicism towards the meaning of school (CYN) and sense of inadequacy as a student (INAD). Each subscale comprised three items which were assessed using a 6-point Likert scale ranging from 1 (completely disagree) to 6 (completely agree). A multilingual team translated the scale from Finnish to Swedish.

2.2.6. Individual interest

We used teacher ratings to measure students' interest in mathematics and Swedish (i.e., their mother tongue). The students' mathematics and Swedish teachers were asked to evaluate the students' motivation and activity in class and rate the students' interest in these subjects on a 5-point Likert scale. They

received a name list of their students by class (e.g., class 9b) and were requested to fill in the ratings for every student.

2.2.7. Educational aspirations

We measured the students' idealistic and realistic educational aspirations according to two statements on a 3-point Likert scale (vocational upper secondary education, polytechnic education and university education): 'Highest academic degree I want to achieve' and 'Highest academic degree I will probably achieve'.

2.2.8. Upper secondary education track

Information on students' educational track (vocational or academic) was collected from schools. First, information from all 14 comprehensive schools where the students had applied was collected. Second, the upper secondary schools were contacted to get confirmation that the students were studying there. If this was not the case, the students themselves were contacted to get the information.

2.2.9. School dropout

School dropout in this study refers to students not enrolled in education 2 years after Grade 9. Of the original sample of 1,152 students, 55.4% (n = 639) were studying at general upper secondary schools, 36.9% (n = 426) were studying at vocational upper secondary school and 3% (n = 35) of the students were not on any educational path at the time of the second data collection. Of these latter students, 37.1% had never started secondary school, 51.4% dropped out from a vocational upper secondary school and only 11.4% dropped out from a general upper secondary school. Furthermore, there was a heterogeneous group of students (n= 52) that included those who were studying abroad, combining general and vocational upper secondary studies or studying at folk high schools that do not give qualifications for specific professions.

2.2.10. Parental educational background

Students were asked to report their mother's and father's highest educational degrees on a 6-point scale (1 = no education, 2 = short course-based vocational

education, 3 = vocational education, 4 = vocational education in combination with the matriculation exam, 5 = polytechnic and 6 = university degree).

2.3. Data Analysis

A common feature in all studies was the use of structural equation models to analyse the data. Structural equation models refer to general statistical procedures for multiequation systems that include continuous or categorical latent variables, multiple indicators of constructs, errors of measurement, errors in equations, and observed variables (Bollen, 1989). In addition to structural equation models, some more traditional analyses (e.g., ANOVA) were also used in this dissertation study. The data analyses were conducted with SPSS and the Mplus statistical program (Muthén & Muthén, 1998-2011).

2.3.1. Missing data analysis

Missing data were imputed using the expectation-maximisation (EM) algorithm (Dempster, Laird, & Rubin, 1977) implemented in SPSS in study II, III, and IV. Concerning study III, only the time point two KTLT scores were imputed. Additionally, the full information maximum likelihood estimation procedure implemented in Mplus that uses all available data in the analyses was implemented in the latent change score models in study III, and in the structural equation path model in study I. These approaches are superior to deletion methods (e.g., listwise deletion) as they produce unbiased parameter estimates when data are missing at random (MAR), while listwise deletion requires that data are missing completely at random (MCAR) (Enders, 2010).

2.3.2. Confirmatory factor analysis and latent factor path analysis

In confirmatory factor analysis (CFA) an a priori factor model is fitted to the data. The factor model (measurement model) consists of a set of observed variables that serve as factor indicators and the latent factors that are not observed directly. This allows the researcher to test if the a priori factor structure that is based on theoretical knowledge fit the data, and to control for measurement error in the latent factor(s) (Brown, 2006). The Mplus statistical

program was used to estimate the parameters of the model using maximum likelihood estimation. Goodness of fit was evaluated using a combination of fit indices. We used the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) as model-fit indicators. The CFI and TLI vary along a 0-to-1 continuum, and values greater than 0.90 and 0.95 typically reflect acceptable and excellent fit to the data, respectively. RMSEA values of less than 0.05 and 0.08 reflect a close fit and a reasonable fit to the data, respectively (Marsh, Hau, &Wen, 2004).

Latent factor path analysis (SEM) combine CFA and multivariate regression analysis. The structural relations between the latent constructs) and possible covariates are of interest in SEM. Usually, the researcher starts with CFA to investigate the plausibility of the measurement model, and after that moves to investigate the structural part of the model with SEM. Model fit indices are used in a similar way as in CFA to examine how well the model fits the data. CFA and SEM were used in study I, while multiple group CFA and multiple group SEM were used in study II. In study III we used longitudinal CFA and latent change score analysis and in study IV, CFA and latent profile analysis.

2.3.3. Multiple group confirmatory factor analysis

Multiple group CFA is an extension of the CFA model. The goal with this analysis is to determine if the measures used in the study are invariant across groups (i.e., measure the same constructs in the same way) to be able to reliably compare groups on the latent constructs under study. To test for measurement invariance, a series of nested models are specified, where the endpoints are the least restrictive model with no invariance constraints, and the most restrictive model that constrains all parameters to be the same across all groups (Bollen, 1989). If the goal is to compare groups in structural relations between the constructs, it is sufficient if the factor loadings are invariant across groups (metric invariance). Invariant factor loadings and intercepts are required if the goal is to compare groups in latent means (scalar invariance). One can use chi-square difference testing to measure the statistical significance between nested models (Bentler, 1990). Another viable option is to compare fit indices between models (Chen, 2007). Since chi-square difference testing tends to be biased toward significance when the sample size is large (see

Marsh, Hau, Balla, & Grayson, 1998), we decided to compare the models in terms of fit indices (CFI and RMSEA). According to Chen (2007), support for the more parsimonious model requires a change in CFI (ΔCFI) of less than .01 or a change in RMSEA (ΔRMSEA) of less than .015.

2.3.4. Longitudinal confirmatory factor analysis

Longitudinal CFA is another extension of the CFA model bearing resemblance to multiple group CFA. Instead of establishing measurement invariance across groups, the goal of longitudinal CFA is to ensure the researcher that the constructs under study are invariant over time. With this approach, the researcher can confidently rule out the possibility that changes in the measurement model, or measurement error would account for the temporal changes in the constructs under study. The invariance testing follows similar steps as in multiple group CFA. A series of nested models are compared from the least restrictive to the most restrictive model. If the goal is to study changes over time, scalar invariance is required (equal factor loadings and intercepts). As in multiple group CFA we decided to compare the models in terms of fit indices (CFI and RMSEA). According to Chen (2007), support for the more parsimonious model requires a change in CFI (ΔCFI) of less than .01 or a change in RMSEA (ΔRMSEA) of less than .015.

2.3.5. Latent change score analysis

Latent change score (LCS) analysis is a special case of longitudinal structural equation modelling (McArdle & Nesselroade, 2014). The purpose of LCS analysis is to investigate differences in latent means over time. When using observed change scores in analyses it is not possible to separate "true" change from measurement error (e.g., Cronbach & Furby, 1970). LCS are part of the model rather than part of the data, as the LCS can be modelled as a latent variable in the model. There are several different ways to specify the model to obtain a LCS factor (McArdle & Nesselroade, 2014; Steyer, Partchev, & Shanahan, 2000), but a common feature in all of these approaches are that they require longitudinal measurement invariance of the constructs under study. In the approach used in study III, both the initial level (LEVEL) and change (CHANGE) were modelled

as latent variables using the same rationale as in latent growth curve modelling. In the model, factor loadings are invariant over time, all intercepts are fixed at zero, and residuals of the corresponding items over time points are correlated. The coefficients of the LEVEL are fixed at one and the path from the CHANGE factor to time point one latent factor is fixed at zero, and the path to time point two latent factor is fixed at one as in conventional latent growth curve modelling. However, in this approach the residual variances of the time point one and two latent factors are fixed at zero so that the LEVEL = time point one factor score, and CHANGE = time point two factor score – time point one factor score.

2.3.6. Latent profile analysis

To classify students into homogenous groups with similar patterns of reading and mathematics performance, and academic well-being we used latent profile analysis (LPA) in study IV. LPA is a probabilistic or model-based variant of traditional cluster analysis (Vermunt & Magidson, 2002), which goal is to identify the smallest number of latent classes (groups) that adequately describe the associations among observed continuous variables. In the analyses one class is added each step until the model optimally fits the data. For choosing the best fitting model, Bayesian Information Criteria (BIC) and Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test were used as the statistical criteria. A decrease in BIC when an additional class is added indicates an improvement in model fit. Regarding VLMR, a resulting p value less than .05 indicates that the estimated model is preferable over the reduced model (Lo, Mendell, & Rubin, 2001). Furthermore, the usefulness and interpretableness of the latent classes were also considered.

2.3.7. Analyses of variance and covariance

Analysis of variance (ANOVA) is used to investigate group differences in a dependent variable. Three one-way ANOVAs were used in study I to investigate differences between mathematics performance groups in three language measures. Analysis of covariance (ANCOVA) is used to investigate group differences in a dependent variable while controlling for a continuous variable (or several). Three ANCOVAs were used in study I to investigate differences between mathematics performance groups in one language measure at a time

while controlling for the two other language measures. In study IV, two-way ANCOVAs were performed to investigate differences between the clusters (identified by means of LPA) in the performance and well-being measures, while controlling for the effects of gender and parental educational level.

2.3.8. Chi-square tests and adjusted residuals

Independent samples chi-square test (χ^2) is used to determine if there is an association between two categorical variables. The χ^2 –test was used in study III to investigate the association between MLD groups and educational track and gender. While the association between the latent profiles and dropout was investigated in study IV. In a crosstabulation, observed frequencies are compared to expected frequencies, and the χ^2-test determines if the difference is statistically significant. To determine exactly which cells' observed frequencies differ from the expected frequencies, we investigated the adjusted residual in each cell. If the residual is over the critical value of 1.96 or under -1.96 in a z-distribution the observed frequencies differ significantly from the expected frequencies.

2.3.9. Configural frequency analysis

To examine the stability and change of mathematical learning difficulties over time (study III), configural frequency analysis was applied to the data (von Eye, Spiel, & Wood, 1996). With this approach it is possible to identify patterns of change (or stability) that are more frequent (type) or less frequent (antitype) than would be expected based on some chance model. The first order configural frequency analysis, which assumes that variables under study may show main effects but no interaction effects, was selected as the baseline model for expected frequencies. The observed frequencies from the cross classification of the time point 1 and time point 2 math grouping were compared to the expected frequencies to identify types and antitypes of change and stability in the three groups.

Vivamus imperdiet, nibh ornare varius eleifend, mauris ligula ultrices ante, sed dapibus leo neque id augue. In aliquam, massa in posuere ullamcorper, ante dui suscipit lectus, in venenatis tortor neque id odio.

3. Overview of the Original Studies

3.1. Study I

3.1.1. Aims

To The aim of this study was to investigate the connection between different language skills (i.e., word comprehension, reading comprehension and spelling) and mathematical performance from an LD point of view.

3.1.2. Participants and procedure

The participants in this study were 810 Swedish-speaking Grade 9 students (418 girls and 392 boys) from 14 different lower secondary schools in Finland. Researchers and trained research assistants conducted the measurements with groups of students in their own schools during ordinary lessons. For the purpose of this study, the students were divided into eight performance groups based on their scores on the mathematical achievement test.

3.1.3. Measures

Mathematical skills

The mathematical skills of the students were assessed with the standardized KTLT paper-and-pencil test (Räsänen & Leino, 2005). The KTLT test contains 40 items, with a correct answer being worth 1 point and an incorrect answer worth no points. The students had 40 minutes to complete the scale.

Language skills

Students' language skills were assessed with the LS reading ability test (Johansson, 2005). The subtests we used were word comprehension, reading comprehension and a spelling test. The word comprehension and reading comprehension scales had multiple-choice tasks, and for the spelling test, the words that need to be written were presented verbally for the students.

3.1.4 Data analysis

Analysis of variance techniques (ANOVA and ANCOVA) were used to examine group differences in language skills between the mathematical performance

groups. Furthermore, structural equation modelling was utilized to investigate the unique predictive value of reading and spelling for mathematical skills.

3.1.5. Results

The one-way ANOVA tests revealed significant differences and large effect sizes in all measures between the groups. The lowest performing students in mathematics also had the lowest scores in all of the language measures. These analyses were followed up by 3 one-way ANCOVAs, where one of the language skills was set as the dependent variable and the two others were added in the analysis as covariates. The groups still differed in word and reading comprehension after the adjustments by the covariates, but the group differences in spelling disappeared when word and reading comprehension was controlled for. Next, we specified a structural equation model (SEM) where students' mathematical performance was regressed on a reading factor and a spelling factor. The model fit the data well and revealed that reading indeed predicted mathematical performance but that spelling did not, thus supporting the results from the ANCOVAs.

3.1.6. Discussion

In this study, the relationship between language and mathematical performance was investigated. The group comparisons showed that students with low mathematical performance also had low scores in word and reading comprehension as well as in spelling. This is in line with previous findings that many students have problems in both mathematics and reading. However, the groups did not differ in spelling when word and reading comprehension was controlled for. These results suggest that spelling and mathematics do not seem to have a strong relationship in this age group. This was further supported by the results from the SEM analyses, where the path from spelling to mathematics was non-significant. This is not in line with previous studies that found a relationship between spelling and mathematics. The explanation for these contradicting results could be that most previous studies (1) investigated younger children and (2) did not control for other language skills.

This study has some limitations. It was cross-sectional, whereby the directionality of the effects in our model would need to be replicated in a longitudinal design. It would also be of interest to use measures that are more focused on certain domains in mathematics; in that case, it would be possible to pinpoint where language skills overlap with mathematical skills more specifically. Future studies should apply more detailed measures of both skills in a longitudinal setting.

3.2. Study II

3.2.1. Aims

The aim of this study was to examine lower secondary school students' pathways to educational aspirations. The study used a multigroup SEM to investigate the predictions of academic self-concept, school burnout, achievement and interest in mathematics and reading in relation to the educational aspirations of boys and girls.

3.2.2. Participants and procedure

The participants in this study were 1,152 Swedish-speaking Finnish students (576 girls and 576 boys). All students were measured at the end of Grade 9 (mean age = 15.8 years, SD = 4.9).

3.2.3. Measures

Mathematics achievement

The mathematical skills of the students were assessed with the standardized KTLT paper-and-pencil test (Räsänen & Leino, 2005). The KTLT test contains 40 items, with a correct answer being worth 1 point and an incorrect answer worth no points. The students had 40 minutes to complete the scale.

Reading achievement

Students' reading skills were assessed with the LS reading ability test (Johansson, 2005). The subtests we used were word comprehension and reading comprehension that both consisted of multiple-choice tasks.

Academic self-concept
Academic self-concept was measured with 8 items from the Perceived Competence Scale for Children (Harter, 1982).

School Burnout
School burnout was assessed using the SBI inventory, which is 9-item scale developed by Salmela-Aro and Näätänen (2005). The inventory consists of three subscales: exhaustion, cynicism and inadequacy.

Interest in mathematics and Swedish
To measure students' interest in mathematics and Swedish (i.e., mother tongue), we used teacher ratings.

Educational aspirations
We measured students' idealistic and realistic educational aspirations according to two statements on a 3-point Likert scale (vocational upper secondary education, polytechnic education and university education): 'Highest academic degree I want to achieve' and 'Highest academic degree I will probably achieve'.

3.2.4. Data analysis

We conducted multiple-group confirmatory factor analyses (CFA) to establish measurement invariance for boys and girls and multiple group SEM path modelling to answer our research questions.

3.2.5. Results

Overall, academic self-concept was the strongest predictor of educational aspirations for both genders. Mathematics achievement was more important than reading achievement for boys' educational aspirations, while for girls, reading achievement was more important. The effect from reading achievement to aspirations was indirect, mediated by interest in reading for both genders. Mathematics achievement predicted aspirations directly for boys, but for girls, the effect was mediated by an interest in mathematics. However, interest in mathematics did not predict boys' educational aspirations. School burnout had a negative indirect effect on aspirations through interest for both genders. Surprisingly, school burnout also had a direct positive effect on aspirations for girls.

3.2.6. Discussion

The aim of this study was to examine gendered pathways to educational aspirations. We found that student achievement in mathematics and reading and academic well-being were related to educational aspirations alongside motivational beliefs and that these relationships somewhat varied as a function of gender.

Overall, mathematics achievement was more important than reading achievement for boys' educational aspirations, while girls showed the opposite pattern. This finding partly reflects the rationale behind the I/E frame of reference model (Marsh, 1986) and gender-typical comparisons. It seems that boys identify themselves more strongly with the mathematics domain than with the reading domain and, consequently, place more emphasis on mathematics achievement, while the opposite pattern may be more likely for girls.

However, there was still small significant indirect effects through interest in the gender-atypical domain for both genders. This finding suggests that within the domains that are less important for a particular student, in order for the student's achievement to have an effect on his/her educational aspirations, the student needs to be interested in the particular subject. It is also worth noting that mathematics achievement had a direct effect on educational aspirations for boys but not for girls. This is in line with previous studies that have found that boys tend to rely more on their own achievement in particular subjects in their decision-making processes, while girls' choices are more directed by their interest towards the subject.

Academic self-concept had a positive direct effect on educational aspirations and was the strongest predictor among the variables for both boys and girls. This could reflect the nature of the transition to upper secondary education in the Finnish school system. In general, it is more difficult to get admitted to the academic track compared to the vocational track, and therefore students' ability beliefs are important. Academic self-concept is also a domain-general construct whereas the interest and achievement variables are domain-specific and hence share some of the variance in the prediction of educational aspirations. More importantly, having domain-specific self-concept in the model could have revealed additional gendered pathways to educational aspirations.

In line with recent studies on the consequences of students' socio-emotional strain, school burnout negatively predicted interest in both reading and mathematics and, through them, educational aspirations. However, we also found a positive direct effect of school burnout on aspirations for girls, which could indicate that ambitious and success-oriented girls invest more effort in school and may experience higher levels of school burnout while at the same time holding high educational goals and plans.

3.3. Study III

3.3.1. Aims

The aim of this study was to investigate the change and stability of MLDs and academic well-being in adolescent students. Students were divided into three groups based on their mathematics performance measured in Grade 9 and 2 years later when they were in an upper secondary school. Furthermore, students with persistent MLDs were compared to low-achieving and typically-achieving students on measures of academic self-concept and school burnout over two time points.

3.3.2. Participants and procedure

The participants in this study were drawn from 1,152 Swedish-speaking Finnish students (576 girls and 576 boys). All students were measured at the end of Grade 9 (mean age = 15.8 years, SD = 4.9). Of the original 1,152 students, 980 students completed the mathematics achievement test at time point 1. In this study, these students were included in the analyses. The follow-up took place during the spring of 2010 when the students were attending either a vocational or general upper secondary school (mean age = 17.9 years, SD = 4.9 months). The first data collection (2008) was performed by the researchers and trained research assistants who conducted the measurements with groups of students in their own schools during ordinary lessons. The second data collection (2010) was performed by trained research assistants who conducted the measurements with groups of students in their respective schools during or after the school day.

3.3.3. Measures

Mathematical skills

The mathematical skills of the students were assessed using the standardized KTLT paper-and-pencil test (Räsänen & Leino, 2005). The KTLT test contains 40 items, with a correct answer worth 1 point and an incorrect answer worth no points. The students had 40 minutes to complete the scale.

Academic self-concept

Academic self-concept was measured with 8 items from the Perceived Competence Scale for Children (Harter, 1982).

School Burnout

School burnout was assessed by the SBI, which is 9-item scale developed by Salmela-Aro and Näätänen (2005). The inventory consists of three subscales: EXH, CYN and INAD.

Upper secondary educational track

Information on the students' educational track (vocational or academic) was collected from the schools. First, information from all 14 comprehensive schools where the students had applied was collected. Second, the upper secondary schools were contacted to get confirmation of whether the students were studying there. If this was not the case, the students themselves were contacted to get the information.

3.3.4. Data analysis

Configural frequency analysis was used to investigate the change and stability of typically-achieving students, low-achieving students and students with MLDs. We used an independent sample chi-square test (χ^2) to determine if there were an association between group membership and educational track and between group membership and gender. Longitudinal CFAs were conducted to establish measurement invariance of the academic self-concept and school burnout constructs of the two time points. Latent change score modelling was used to investigate changes in the academic well-being measures from Grade 9 to upper secondary school and if typically-achieving students, Low-achieving students and students with MLDs differed in this aspect. Missingness of data was also

analysed, and the expectation-maximization algorithm was used to impute missing values of the mathematics achievement test at time point 2. Furthermore, both maximum likelihood estimation procedures (which assume that data are missing at random) and pattern-mixture modelling (which can be used when data are not missing at random) were used in the latent change score models to ensure unbiased results in relation to missing data.

3.3.5. Results

We used the 25th percentile as the cut-off value for typically-achieving, low-achieving was defined as scores between the 10th and 25th percentile, and MLD was defined as scoring under the 10th percentile. All three groups showed stability (91%, 70% and 87%) from Grade 9 to secondary school, meaning that these configurations occurred more often than expected from chance ($p < .001$). Four untypical patterns (antitypes of change) were also identified, meaning that these change configurations occurred less often than expected from chance ($p < .001$). These were all configurations that incorporated students who had been identified as typically-achieving at one time point and low-achieving or MLD at the other time point. Group membership was associated with each students' secondary education track [$\chi^2(2, N = 820) = 134.49, p < .001$], showing that students in the typically-achieving group ($z = 11.2, p < .001$) were more likely to study at general upper secondary schools, whereas students in the low-achieving ($z = -6.9, p < .001$) and MLD ($z = -8.3, p < .001$) groups were more likely to study at vocational upper secondary schools. The gender distribution was not significantly different across groups [$\chi^2(2, N = 885) = .44, p = .80$], indicating that girls and boys showed similar prevalence rates of low-achieving and MLD.

Both academic self-concept and school burnout were invariant over the two time points. Concerning academic self-concept, both the low-achieving and MLD groups had lower scores in Grade 9 compared to the typically-achieving group. The magnitude of the regression paths from the low-achieving and MLD groups were similar, indicating no differences in academic self-concept in Grade 9 between them. The students in the three groups showed similar changes in academic self-concept from Grade 9 to upper secondary school. The academic-track students had higher academic self-concept in Grade 9, but their change was

negative, while the vocational-track students had lower academic self-concept in Grade 9, but they increased in upper secondary school. The interaction between the educational track and low-achieving group was marginally significant (p = .06) on the intercept in academic self-concept. Low-achieving students that continued to the academic track did not differ in academic self-concept compared to the low-achieving students continuing to the vocational track as much as students within the typically-achieving and MLD groups.

Vocational track students in general experienced higher levels of school burnout in Grade 9, but there was also a significant educational track by MLD group interaction (p < .05) on level of school burnout. The MLD students continuing to the academic track clearly showed a different pattern. They experienced the highest levels of school burnout, while within the other groups, the academic-track students had lower school burnout compared to the vocational-track students. Change in school burnout was predicted by educational track, educational track and low-achieving group and educational track and MLD group. The typically-achieving students in the academic track showed the highest increase in school burnout compared to all other groups, while the typically-achieving students in vocational education experienced a decrease in school burnout. The interaction pattern was similar in the low-achieving students, although the academic-track students within this group had more or less stable school burnout across both time points. The MLD group's interaction with the educational track was different; the vocational-track students had a smaller decrease in school burnout compared to the other groups, whereas the academic-track students showed the biggest decrease in SB compared to all other groups.

3.3.6. Discussion

The aim of this study was to investigate change and stability in MLDs and academic well-being across the transition to upper secondary school. The configural frequency analyses showed that the grouping of students into typically-achieving, low-achieving and MLD groups was stable during this 2-year period. However, consistent with the literature, not all students classified as MLD remained in this group. This supports the use of the persistence

criterion when identifying students with MLD. The changes in academic self-concept were mainly explained by the educational track of the students—the academic-track students experienced a decrease in academic self-concept, while the vocational-track students experienced an increase in academic self-concept. This result mirrors findings concerning the social comparison effect in the literature (e.g., the BFPLE). The low-achieving and MLD groups had lower academic self-concept in Grade 9 compared to the typically-achieving group, but similar changes in academic self-concept. The only difference found between the low-achieving students and students with MLD was that the low-achieving students in the academic track did not differ as much in academic self-concept compared to the vocational-track low-achieving students as was the case within the other groups. Educational track continued to be an important predictor also when investigating school burnout. However, here the interaction effects played a more dominant role, and especially students with MLD in the academic track exhibited differing patterns in both the level (Grade 9) and change of school burnout. It seems that these students had to put a lot of effort into their studies in Grade 9 to be able to continue to the academic track. This is reflected by their very high levels of school burnout compared to all other groups. Interestingly, they also experience the sharpest decline in school burnout in upper secondary school, which could indicate that they mainly chose other non-mathematics subjects in the academic track, thus lessening the impact of their MLDs on their school burnout. It is worth noting that the typically-achieving students in the academic track experienced an increase in school burnout, while the low-achieving students in the academic track show a more stable trend in their school burnout.

3.4. Study IV

3.4.1. Aims

The aim of this study was to examine lower secondary students' performance (reading and mathematics) and academic well-being (academic self-concept, perceived learning difficulties and school burnout) profiles and the relationship between these profiles and dropping out of school.

3.4.2. Participants and procedure

The participants in this study were 1,152 Swedish-speaking Finnish students (576 girls and 576 boys). All students were measured at the end of Grade 9 (mean age = 15.8 years, SD = 4.9). Research assistants tracked down students by phone and social media who did not participate in the second data collection. This way we could determine educational status (i.e., whether they were in school or had dropped out) for all but two students.

3.4.3. Measures

Mathematical skills

The mathematical skills of the students were assessed with the standardized KTLT paper-and-pencil test (Räsänen & Leino, 2005). The KTLT test contains 40 items, with a correct answer worth 1 point and an incorrect answer worth no points. The students had 40 minutes to complete the scale.

Reading skills

Students' reading skills were assessed with the LS reading ability test (Johansson, 2005). The subtests we used were word comprehension and reading comprehension, which both consist of multiple-choice tasks, and a spelling task.

Academic self-concept

Academic self-concept was measured with 8 items from the Perceived Competence Scale for Children (Harter, 1982).

Perceived learning difficulties

Perceived learning difficulties were assessed by 9 items measuring how much difficulty a student experienced while competing their schoolwork (e.g., taking notes in class, understanding instructions on the whiteboard, etc.). Each item was assessed using a 7-point Likert scale ranging from 1 (not at all) to 7 (very much).

School burnout

School burnout was assessed by the SBI, which is 9-item scale developed by Salmela-Aro and Näätänen (2005). The inventory consists of three subscales: exhaustion, cynicism and inadequacy.

3.4.4. Data analysis

To classify students into homogenous groups with similar patterns of reading and mathematics performance and academic well-being, we used latent profile analysis (LPA). LPA is a probabilistic or model-based variant of the traditional cluster analysis (Vermunt & Magidson, 2002), the goal of which is to identify the smallest number of latent classes (groups) that adequately describe the associations among observed continuous variables. We used an independent sample chi-square test (χ^2) to determine if there were an association between group membership and dropout. Missing data were handled with imputation of missing values with the expectation-maximization algorithm, and the proposed factor structure of the measures was tested with CFAs.

3.4.5. Results

The CFAs confirmed the factor structure of the performance and academic well-being measures. In order to group students into different academic performance and well-being profiles, a series of LPAs was conducted. The analyses revealed that a four-group solution best described the data. The four groups were labelled according to the mean score of their profiles in the academic performance and well-being measures as high-performing, average-performing, low-performing and negative academic well-being.

ANCOVAs were conducted to investigate group differences in the latent factor scores of all the measures while controlling for the effects of parental educational background and gender. Six students had missing information on gender and were therefore not included in the analyses. The students in the high-performing group (n = 391, 34%) performed significantly better on all performance measures compared to the other groups, reported lower levels of school burnout and perceived learning difficulties and displayed the highest level of academic self-concept. The average-performing students (n = 473, 41%) represented students with typical performance and average levels of academic well-being. They tended to perform better and display higher academic well-being compared to the low-performing group and the negative academic well-being group.

The low-performing students (n = 204, 18%) exhibited severe learning difficlties in reading, spelling and mathematics (mean scores < -1.27 SD) and reported lower levels of academic well-being compared to the high-performing and average-performing students. The negative academic well-being group (n = 78, 7%) represented students that, despite their average performance levels, reported the lowest levels of academic well-being. They had lower academic self-concept and reported higher levels of perceived learning difficulties and school burnout, even when compared to the low-performing group. The χ^2-test revealed that students from the low-performing group and negative academic well-being group exhibited a higher risk of dropping out of school compared to the other groups. We also investigated if students who had dropped out from school had lower parental educational levels, but this was not the case.

3.4.6. Discussion

We found support for four distinct academic performance and well-being profiles that showed similar performance levels in mathematics, reading and spelling within groups. The low-performing group can be viewed as corresponding to the MLDRD group, as these students performed at a lower level in mathematics and all reading measures compared to the other groups. We also identified one group of students who, despite their rather average performance, experienced the lowest levels of academic well-being. This group exhibited an increased risk for dropping out of school, which is in line with previous studies. A common feature for these students is that they exhibit maladaptive patterns of functioning at school, and consequently, they are in danger of dropping out of school. Furthermore, one group of average-performing students and one group of high-performing students were identified.

Academic performance in reading, spelling and mathematics was strongly related to academic well-being except for in the group with average performance and low well-being. These findings support previous studies that point to the need to also consider academic well-being in school settings, as there are clearly students who do not have difficulties performing academically but still do not feel comfortable in school.

4. General Discussion

This dissertation study investigated the relationships among learning difficulties, academic well-being and educational pathways. Overall, the results of this dissertation demonstrated that learning difficulties in mathematics and reading were closely related and had a strong influence on educational aspirations and school dropout (Figure 2). Learning difficulties in mathematics and reading were also associated with lower academic well-being. Furthermore, academic well-being was found to be related to school dropout and educational aspirations, and it developed differently in general upper secondary schools and vocational upper secondary schools.

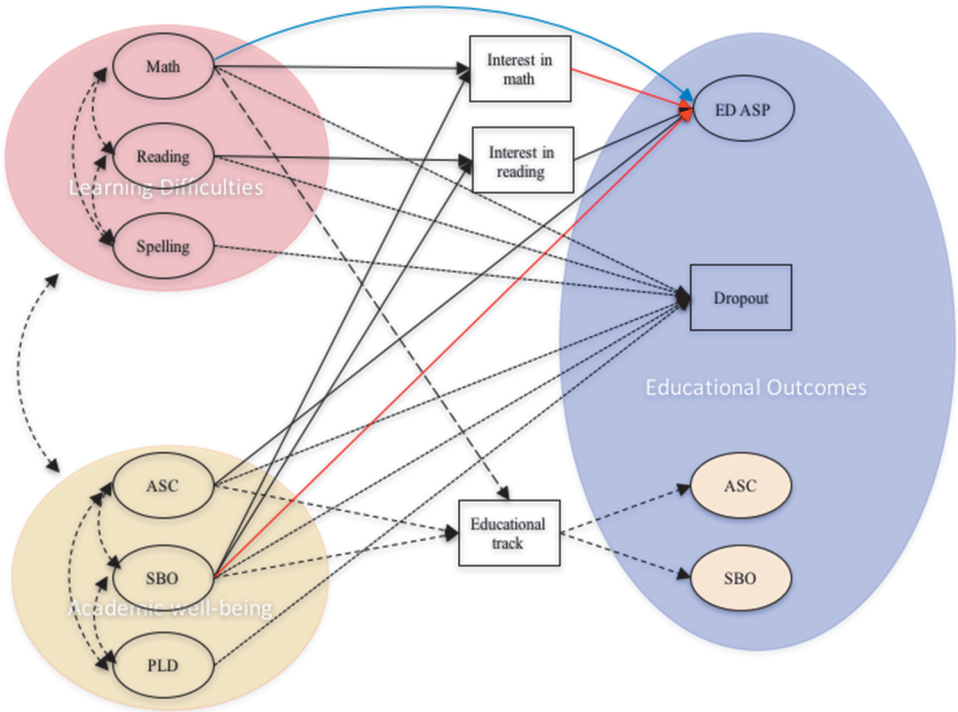

Figure 2. Empirical model of adolescent students' educational pathways based on the results of this dissertation study, where learning difficulties and academic well-being predict educational outcomes; ASC = academic self-concept, SBO = school burnout, PLD = perceived learning difficulties, ED ASP = educational aspirations, educational track = general or vocational upper secondary education. Note: The red arrows represent relationships found only for girls, and the blue arrows represent relationships found only for boys.

4.1. Learning Difficulties in Mathematics and Reading

The first aim of this dissertation was to investigate the relationship between learning difficulties in mathematics and reading. In study I, the focus was on examining how different subskills in reading are related to mathematical performance. Previous work has mainly focused on how reading skills in general (e.g., Jordan et al., 2003) or dyslexia in particular (Landerl et al., 2009; Simmons & Singleton, 2008) are related to mathematical performance. In line with previous research, a strong relationship between mathematical performance and word and reading comprehension was found, but only a weak or non-existent relationship between spelling and mathematical performance.

Previous studies (Ostad, 1998) have found mathematical performance and spelling to be related, but these studies have mainly focused on younger children and did not control for other reading skills. The results from study IV support and complement these findings. In study I, the relationship was studied using variable-centred methods (i.e., SEM path-model), whereas in study IV, a person-centred method was adopted to study learning difficulties in mathematics and reading (latent profile analysis). The analyses identified one group of students with learning difficulties in both reading and mathematics.

The empirical data did not support the traditional grouping used in learning difficulties research (RD-only, MLD-only and MLDRD groups). However, both MLDs and RDs may incorporate different subtypes (e.g., Skagerlund & Träff, 2014), and not all students who show low achievement in mathematics/reading at one time point have persistent and severe learning difficulties (e.g., Fletcher et al., 2005). In this study, only performance measures were included in the latent profile analyses, but to separate, for example, students with RD from low-achieving students, cognitive indicators such as phonological processing (Vellutino et al., 2004) or naming speed (Kirby et al., 2010) would have needed to be included. In previous studies low-achieving students have been found to differ from typical-achieving students in general domain skills (e.g., working memory), while students with MLDs and RDs differ from low- and typical-achieving students in domain-specific measures (e.g., number sense, naming

speed). It is likely that the learning difficulties group identified in study IV also included low-achieving students.

These results indicate that if learning difficulties in respective domains are defined with a low score on a performance measure, a lot of students will be categorized as having MLDRD in this age group. This result could reflect the viewpoint that some shared-domain general skills like working memory (e.g., Kyttälä, 2008) can explain this co-occurrence. Moreover, as the results from study I highlight, mathematical skills in general require good language skills in terms of word and reading comprehension (LeFevre et al., 2010; Vukovic & Lesaux, 2013b), which also contributes to the strong relationship between mathematics and reading. Particularly in this age group, mathematics often involves word problem solving that requires good language skills and good working memory capacity.

4.2. Learning Difficulties and Academic Well-Being

Overall, students' mathematics performance (studies II, III and IV) and reading performance (studies II and IV) were related to lower academic well-being. More specifically, students with learning difficulties in mathematics or/and reading had lower academic self-concept and higher school burnout and perceived learning difficulties in Grade 9 compared to their typically performing peers. In light of the literature and the conceptualization of academic well-being in general, as well as the indicators used in this study in particular, these results are expected. Academic self-concept refers to students' beliefs in their ability in academic domains and incorporates a social comparison dimension (Marsh, 1986). Therefore, it is hardly surprising that students who perform at a lower level compared to their peers do not feel as competent in school settings. If we had measured domain-specific self-concepts in reading and mathematics, the results might have changed. For example, students with only MLD would probably exhibit low mathematics self-concept but might experience similar levels of reading self-concept as typically-achieving students. Based on the I/E frame of reference model (Marsh, 1986), it might even be that they would show

relatively high reading self-concept compared to their actual skill level as a result of the internal comparison process.

Concerning school burnout, the higher levels experienced by students with learning difficulties probably reflects that they have to work harder in school, thus depleting their psychological resources (Tuominen-Soini & Salmela-Aro, 2014). Another, interpretation of the relationship between school burnout and learning difficulties found in the literature on motivation and well-being is that these students give up easily on academic tasks and do not invest effort in their school work (Tuominen-Soini et al., 2012). Similarly, perceived learning difficulties were also related to learning difficulties. This is understandable, as students with learning difficulties most likely struggle to follow the general instructions given in the classroom and are in need of additional support. It is also worth noting that we also found a group of students in study IV that showed average performance in reading and mathematics but exhibited lower levels of academic well-being compared to the learning difficulties group. This finding reflects that low academic well-being at a given point in time is not always related to learning difficulties and, consequently, learning difficulties are not always the cause for low academic well-being. However, it is plausible to assume that negative academic well-being can, over time, result in lower achievement in these students.

4.3. Changes in Academic Well-Being Related to Mathematical Learning Difficulties Across the Transition to Upper Secondary Education

Study III investigated changes in academic well-being measures from Grade 9 to upper secondary school in relation to MLDs. In Grade 9, the students who continued to the academic track had higher levels of academic self-concept compared to students who continued to the vocational track. This was expected, as academic self-concept is strongly related to achievement level (e.g., Marsh et al., 2002). Furthermore, as expected, the low-achieving and MLD students showed lower levels of academic self-concept compared to the typically-achieving students (Bear et al., 2002; Zeleke, 2004). On the whole sample level,

there was an increase in academic self-concept in the vocational track and a decrease in academic self-concept in the academic track compared to Grade 9. This result fits well with the BFLPE (Marsh & Craven, 2002), as students in the academic track face tougher competition in terms of social comparisons compared to compulsory education, while the opposite pattern is true for vocational-track students. Although this effect has also been found when comparing students with learning difficulties in inclusive versus segregated settings (Marsh et al., 2006), we did not find interaction effects between educational track and the typically-, low-achieving and MLD groups on change in academic self-concept. This probably reflects that in both tracks, the low-achieving and MLD students are still performing at the lower end, resulting in similar social comparison processes.

Students from all three groups who continued to the vocational track reported a decrease in school burnout compared to Grade 9. However, differences were found between all groups among students in the academic track. Typically-achieving students in the academic track exhibited an increase in school burnout compared to Grade 9, which is line with previous studies (Salmela-Aro et al., 2008; Salmela-Aro & Tynkkynen, 2012; Salmela-Aro & Upadyaya, 2014b). Interestingly low-achieving students showed a stable trend, and MLD students showed a decreasing trend in school burnout compared to Grade 9. These students have probably chosen to focus on other subjects than mathematics, thus reducing the negative impact of their difficulties in mathematics on their academic well-being. Therefore, it seems plausible that in Grade 9 these students invested effort into mathematics because they had been aiming for the academic track, thus experiencing more school burnout, but once they were in the academic track, they directed their motivation and effort to areas other than mathematics. This pattern was even more pronounced in the MLD students in the academic track who had the highest level of school burnout in Grade 9 but exhibited the steepest decrease in school burnout during the educational transition. This finding is similar to a study by Salmela-Aro and Upadyaya (2014b), who found that those students with a high initial and decreasing change in school burnout held lower educational aspirations than groups with either low-increasing or low-stable school burnout profiles. The results in study III

reflect similar processes in the MLD group (in the academic track), where these students had decided not to pursue educational pathways that included mathematics, thus reducing the negative impact of their MLD on their academic well-being. As stated previously, including domain-specific measures of self-concept would provide a more detailed picture of how students' beliefs in their ability develop in relation to their learning difficulties in mathematics. Similarly, school burnout is also considered a domain-general measure, and therefore, for example, perceived cost in the domain of mathematics could be of interest here.

4.4. Learning Difficulties and Academic Well-Being Predicting Educational Aspirations and Potential for Dropping Out

The fourth aim of this study was to investigate the contribution of learning difficulties in mathematics and reading and academic well-being on outcomes such as educational aspirations (study II) and school dropout (study IV). Concerning educational aspirations, student achievement in mathematics and reading and academic well-being were related to educational aspirations alongsides motivational beliefs and that these relationships somewhat varied as a function of gender. These findings indicate that overall, students who are low-achieving or who have learning difficulties in mathematics and reading hold lower educational aspirations compared to their typically-achieving peers. Moreover, in line with previous research, boys identify themselves more strongly with the mathematics domain than with the reading domain and, consequently, place more emphasis on mathematics achievement, while the opposite pattern may be more likely for girls (Eccles, 2009; Nagy et al., 2006; Meece, Glienke, & Burg, 2006). Therefore, it is plausible to assume that MLDs are more detrimental for boys' future educational pathways, while RDs are more detrimental for girls. Another interesting finding is that boys tend to rely more on their own subject achievement (i.e., mathematics performance) in their decision-making processes (Nagy et al., 2006; Viljaranta et al., 2009), while girls' choices are more directed by their interest towards the subject (Chow et al., 2012; Watt et al., 2012).

The results also show that learning difficulties are not by themselves sufficient to explain educational aspirations. Academic well-being in terms of academic

self-concept and school burnout uniquely predicted educational aspirations in the model. Students that hold higher ability beliefs (academic self-concept) set higher educational goals, while students that experience school burnout loose interest in their school work, which leads to lower educational aspirations. This pattern was similar for boys and girls, but one interesting difference concerning school burnout emerged. Higher levels of school burnout among girls seems to directly influence their educational aspirations positively. This could indicate that ambitious and success-oriented girls invest more effort in school and may experience higher levels of school burnout, while at the same time holding high educational goals and plans (Tuominen-Soini et al., 2008; Tuominen-Soini & Salmela-Aro, 2014).

Study IV focused on explaining dropout from secondary schools by measures of performance and well-being. In this study, a person-centred approach was used to group students and did not result in separate MLD or RD groups, but only one group of students with combined difficulties in mathematics and reading. Consequently, it is not possible to determine if MLD or RD predicts dropout more strongly based on this study. Consistent with previous findings (Battin-Pearson, et al., 2000; Janosz, et al., 2000), learning difficulties were a good predictor of dropout from secondary school. Students that formed the lowest-performing group (combined MLD and RD) had the highest risk of dropping out of school, whereas students from the average-performance and high-performance group exhibited the lowest risk of dropping out school. However, the results also demonstrated that there is a group of students that, while having average performance levels in reading and mathematics, experience low academic well-being and consequently have a higher risk of dropping out of school.

Taken together, these findings show that learning difficulties and academic well-being are related to both educational aspirations and school dropout. Moreover, gender was found to moderate the effects of reading and mathematics achievement on educational aspirations while not being related to dropout. As gender differences emerged when contrasting the mathematics and reading domains concerning aspirations, results might have differed concerning dropout if MLD and RD profiles had been found. The results also show the importance

to link studies on learning difficulties and well-being to existing theories to get a more holistic picture of the processes influencing educational outcomes and to better understand the results obtained. More specifically, the expectancy-value framework helped us build the model for students' educational aspirations and include the interest variables as mediators between the achievement measures and educational aspirations, whereas the I/E frame of reference model was useful for interpreting the gendered effects from reading and mathematics achievement to aspirations, indicating that internal comparison processes can lead to students opting out from educational pathways that focus on the domain that they feel less competent in. An example of this would be girls choosing not to pursue STEM-related educational paths (Nagy et al., 2006; Watt et al., 2012) even though they perform at similar level in mathematics compared to boys (Else-Quest, Hyde, & Linn, 2010).

4.5. Strengths and Limitations

This dissertation study has some strengths but also several limitations that need to be taken into account when interpreting the results. In all the studies latent constructs were used to take into account measurement error and structural equation modelling techniques were utilized to obtain model fit indices. However, concerning the achievement measures, instead of individual items, item parcels or single indicators of the measures were used. This was done to reduce the complexity of the models but the trade-off of this approach was that not all measurement error was parcelled out in the measurement models concerning reading, mathematics and spelling. Another overall feature of this dissertation study was that different theoretical starting points were used in the original studies. This can be seen as a strength as the overall results are linked and advance previous research in different ways. However, this approach does not come without limitations as the operationalisations of key-constructs (e.g., academic self-concept versus mathematical self-concept) do not always match that of previous research in a given field. This was due to the fact the empirical work this thesis is based on, did not use one specific theoretical model as a starting point, rather a more data-driven approach was adopted.

As study I and other studies (e.g., Vukovic et al., 2010) indicate, the relationship between mathematics and reading varies as a function of how these constructs are operationalized. Some subskills in reading are more strongly related to mathematics compared to others, and some areas in mathematics have higher demands on language than others (Jordan et al., 2003; Vukovic & Lesaux, 2013). Furthermore, both MLD and RD incorporate different subtypes of difficulties that show deficits in different areas. It is of particular importance to distinguish between low-achievement and learning difficulties to be able to advance our current knowledge in MLD and RD research. This can be partly achieved by including multiple measurement occasions (the persistence criterion; Fletcher et al., 2005) and incorporating both groups alongside typically-achieving students in research designs (the thrichotomous approach; Mazzocco & Räsänen, 2013), as was done in study III.

This dissertation study only included performance measures, but research in both MLD and RD has identified underlying cognitive skills that are indicative of these difficulties. More specifically, number processing incorporating nonsymbolic (ANS) and symbolic magnitude comparison skills are indicative of MLD (De Smedt & Gilmore, 2011; Mazzocoo et al., 2011; Skagerlund & Träff, 2014). Similarly, deficits in phonologic processing and naming speed are core features of RD (Vellutino & Fletcher, 2005). Future studies on MLD could—in addition to the persistence criterion and the thrichotomous approach—also include one of these cognitive measures when operationalizing MLD.

To overcome the limitations associated with the use of cut-off scores in RD and MLD research, which vary considerably across studies (from 2.5% to 35%), person-centred methods offer an alternative way of classifying students. Advances in statistical research methods offer researchers the possibility of using model-based groupings of students (e.g., LPA; Vermunt & Magidson, 2002), thereby omitting the need to use arbitrary cut-off scores in research designs. This was done in study IV where latent profile analysis was used to classify students. However, study III used cut-off scores to identify students with low-performance, and mathematical learning difficulties respectively. This resulted in another classification of students compared to study IV making it more difficult to draw coherent conclusions of the findings across studies III and IV.

This decision was driven by the fact that we had not measured all constructs over time (Table 1) and the focus in study III was especially on mathematical learning difficulties.

Concerning educational pathways and educational aspirations in particular, study II demonstrates the need to incorporate both the reading and mathematics domains in the model when trying to explain these outcomes and the processes leading to them. A limitation in our study was that we used a domain general construct in operationalizing academic self-concept. This probably kept us from finding more nuanced predictions from the mathematics and reading domains concerning students' educational aspirations. Our results also highlight the need of incorporating possible gender effects in the model.

We have investigated changes in academic self-concept and school burnout from Grade 9 to upper secondary school among typically-achieving students, low-achieving students and students with MLD. A limitation in this study was the high attrition rate at time point 2. Better cooperation with the upper secondary schools might have decreased the number of students who did not participate in the second data collection. Some schools allowed the research assistant to conduct the measurements during the ordinary school day, while in other schools the data collection had to be performed after the school day. Another limitation concerning this study was that we only measured students' academic self-concept and school burnout once before the transition to upper secondary school. It would be interesting to include multiple measurements during compulsory education to be able to make stronger claims about the changes in academic well-being in the educational and vocational tracks, respectively.

Finally, from a statistical methods view, multiple-group SEM, where both the measurement model and the structural paths between the constructs under study are estimated separately for typically-achieving students and students with learning difficulties, would offer the best and most rigorous approach to investigating similarities and differences between these groups (Wilson & Rupley, 2013). A challenge with this type of analysis is the sample size requirements for the learning difficulties group that, depending on the complexity of the model, would be challenging to achieve.

4.7. Pedagogical Implications

This dissertation study also has some pedagogical implications. Overall, the results concerning the relationship between learning difficulties in reading and mathematics indicate that a large number of students with MLDs also struggle in reading. Therefore, interventions that not only support mathematical skills but also help increase reading comprehension are needed in this age group. A promising method that has been found effective for students with comorbid difficulties in reading and mathematics is Schema Broadening Instruction (Fuchs et al., 2009), which builds on the work of Jitendra and Hoff (1996) and Jitendra, DiPipi and Perron-Jones (2002) concerning math instruction for word problem solving. This instructional method incorporates teaching students to understand the underlying mathematical structure of the problem type, to recognise the basic problem type and to solve the problem type. Additionally, teaching for transfer is explicitly incorporated.

Furthermore, in this study, lower academic self-concept was found to be related to students with learning difficulties. Meta-analytic findings suggest that interventions that target both academic skills and academic self-concept are the most effective (O'Mara, Marsh, Craven, & Debus, 2006). Furthermore, students with learning difficulties seem to profit from interventions that explicitly target self-concept as opposed to those that merely focus on academic skills training (Hattie, 1992; O'Mara et al., 2006). Therefore, incorporating elements (e.g., praise and feedback) that aim to enhance mathematical self-concept are warranted. Prior research (Kamins & Dweck, 1999; O'Mara et al., 2006) has identified praise and feedback as effective components in enhancing self-concept. Moreover, results from study II and III highlight the importance of academic self-concept in the decision-making processes concerning educational pathways, further emphasising the importance of enhancing students' competence perceptions in academic domains.

A group of students with average performance but low levels of academic well-being and an increased risk for dropout from upper secondary school was identified in study IV. This finding emphasises the need to consider academic well-being more systematically in school settings. In Finnish schools, students

are systematically screened for possible learning difficulties and given additional support mainly in the core subjects, such as their mother tongue and mathematics. Unfortunately, students' well-being is not followed up in the same way. Practical means to intervene and to provide all adolescents with adequate coping strategies should be developed. Concrete advice on how to prevent and handle feelings of exhaustion and negative affect might save these students from more severe problems later on, as study-related demands are likely to increase over the course of their education.

Taken together, this dissertation study indicates that it is possible to identify students with learning difficulties and low well-being in upper secondary schools, and that these factors are related to their chances to successfully pursue their personal educational pathway.

References

Andersson, U. (2010). Skill development in different components of arithmetic and basic cognitive functions: Findings from a 3-year longitudinal study of children with different types of learning difficulties. *Journal of Educational Psychology, 102*(1), 115-134.

Andersson, U., & Lyxell, B. (2007). Working Memory Deficits in Children with Mathematical Difficulties: A General or Specific Deficit? *Journal of Experimental Child Psychology, 96*, 197-228.

Archambault, I., Janosz, M., Morizot, J., & Pagani, L. (2009). Adolescent behavioral, affective, and cognitive engagement in school: Relationship to dropout. *Journal of School Health, 79*(9), 408-415.

Augustyniak, K., Murphy, J., & Phillips, D. K. (2005). Psychological perspectives in assessing mathematics learning needs. *Journal of Instructional Psychology, 32*(4), 277-286.

Badin, N. A. (1983). Dyscalculia and Nonverbal Disorders of Learning. In H.R. Myklebust (Ed.), *Progress in learning disabilities* (Vol.5, pp. 235-264). New York: Stratton.

Bakker, A. B., Schaufeli, W. B., Demerouti, E., Janssen, P. P. M., Van der Hulst, R., & Brouwer, J. (2000). Using equity theory to examine the difference between burnout and depression. *Anxiety, Stress and Coping, 13*(3), 247-268.

Barron, K. E., & Hulleman, C. S. (2015). Expectancy-value-cost model of motivation. In J. D. Wright (Ed.), *International Encyclopedia of the Social and Behavioral Sciences* (pp. 503–509). Oxford: Elsevier Ltd.

Battin-Pearson, S., Newcomb, M.D., Abbott, R.D., Hill, K.G., Catalano, R.F., & Hawkins, J.D. (2000). Predictors of early high school dropout: A test of five theories. *Journal of Educational Psychology, 92*(3), 568-582.

Battle, A., & Wigfield, A. (2003). College women's value orientations toward family, career, and graduate school. *Journal of Vocational Behavior, 62*, 56–75.

Bear, G. G., Minke, K. M., & Manning, M. A. (2002). Self-concept of students with learning disabilities: A meta-analysis. *School Psychology Review, 31*(3), 405-427.

Bentler, P. M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*(2), 238–246.

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

Bong, M., & Skaalvik, E. M. (2002). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review, 15(*1), 1-40.

Brown, T. A. (2006). *Confirmatory factor analysis for the applied research*. London: The Guilford Press.

Burnett, P. C., Pillay, H., & Dart, B. C. (2003). The influences of conceptions of learning and learner self-concept on high school students´ approaches to learning. *School Psychology International, 24*, 54-66.

Butterworth, B. (2005). Developmental dyscalculia. In J.I.D. Campbell (Ed.), *The Handbook of Mathematical Cognition* (pp. 455-467). Hove: Psychology Press.

Bynner, J., & Parsons, S. (2002). Social exclusion and the transition from school to work: The case of young people not in education, employment or training (NEET). *Journal of Vocational Behavior, 60*(2), 289-309.

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

Chow, A., & Salmela-Aro, K. (2011). Task values across subject domains: A gender comparison using a person-centered approach. *International Journal of Behavioral Development, 35*, 202–209.

Chow, A., Eccles, J., & Salmela-Aro, K. (2012). Task value profiles across subjects and aspirations to physical and IT-related sciences in the United States and Finland. *Developmental Psychology, 48*(6), 1612–1628.

Cronbach, L. J., & Furby, L. (1970). How we should measure "change": Or should we? *Psychological Bulletin, 74*(1), 68-80.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19*(4), 450-466.

De Smedt, B., & Gilmore, C. K. (2011). Defective number module or impaired access? Numerical magnitude processing in first graders with mathematical difficulties. *Journal of Experimental Child Psychology, 108*(2), 278-292.

De Smedt, B., Noël, M-P., Gilmore, C., & Ansari, D. (2013). How do symbolic and non-symbolic numerical magnitude processing skills relate to individual differences in children's mathematical skills? A review of evidence from brain and behavior. *Trends in Neuroscience and Education, 2*(2), 48-55.

DeGarmo, D. S., & Martinez, C. R. (2006). A culturally informed model of academic well-being for Latino youth: The importance of discriminatory experiences and social support. *Family Relations, 55*(3), 267–278.

Dehaene, S. (2011). *The number sense: How the mind creates mathematics, revised and updated edition*. New York: Oxford University Press.

Dempster, A. P., Laird, N. M., & Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society, Series B, 39*(1), 1-38.

Dirks, E., Spyer, G., van Lieshoult, E. C. D. M., & de Sonneville, L. (2008). Prevalence of combined reading and arithmetic disabilities. *Journal of Learning Disabilities, 41*(4), 460–473.

Domene, J. F., Shapka, J. D., & Keating, D. P. (2006). Educational and career-related help-seeking in high school: An exploration of students' choices. *Canadian Journal of Counselling, 40,* 145–159. Retrieved from http://cjcrcc.ucalgary.ca/cjc/index.php/rcc/article/view/297/678

Domina, T., Conley, A. M., & Farkas, G. (2011). The link between educational expectations and effort in the college-for-all era. *Sociology of Education, 84*(2), 93-112.

Duncan, G. J., & Brooks-Gunn, J. (2001). Poverty, welfare reform, and children's achievement. In B. Biddle (Ed.), *Social class, poverty and education: Policy and practice* (pp. 49–76). New York, NY: Routledge-Falmer.

Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology, 98*(2), 382–393.

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*(2), 78–89.

Eccles, J. S., & Midgley, C. (1989). Stage-environment fit: Developmentally appropriate classrooms for young adolescents. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (pp. 139–186). San Diego: Academic Press.

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 74–146). San Francisco, CA: W. H. Freeman.

Eccles, J. S., Midgley, C., Wigfield, A., Buchanan, C. M., Reuman, D., Flanagan, C., & Mac, I.

D. (1993). Development during adolescence: The impact of stage-environment fit on young adolescents' experiences in school and in families. *American Psychologist, 48*, 90–101.

Eccles, J. S., Roeser, R. W. (2009). Schools, academic motivation, and stage-environment fit. In R. M. Lerner, & L. Steinberg (Eds.), *Individual bases of adolescent development (3rd ed.). Handbook of adolescent psychology, Vol. 1.* (pp. 404-434). Hoboken, NJ: Wiley.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*(1), 103–127.

Enders, C. K. (2010). *Applied missing data analysis*. London: The Guilford Press.

Fall, A-M., & Roberts, G. (2012). High school dropouts: Interactions between social context, self-perceptions, school engagement, and student dropout. *Journal of Adolescence, 35*, 787-798.

Flake, J. K., Barron, K. E., Hulleman, C., McCoach, B. D., & Welsh, M. E. (2015). Measuring cost: The forgotten component of expectancy-value theory. *Contemporary Educational Psychology 41*, 232–244.

Fletcher, J. M., Denton, C., & Francis, D. J. (2005). Validity of alternative approaches for the identification of learning disabilities: Operationalizing unexpected underachievement. *Journal of Learning Disabilities, 38*, 545–552.

Fortin, L., Marcotte, D., Potvin, P., Royer, É., & Joly, J. (2006). Typology of students at risk of dropping out of school: Description by personal, family and school factors. *European Journal of Psychology of Education, 21*(4), 363-383.

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence, 20*, 507–537.

Friso-van den Bos, I., van der Ven, S. H. G., Kroesbergen, E. H., & van Luit, J. E. (2013). Working memory and mathematics in primary school children: A meta-analysis. *Educational Research Review, 10*, 29-44.

Fuchs, L. S., Fuchs, D., Compton, D. L., Bryant, J. D., Hamlett, C. L., & Seethaler, P. M. (2007). Mathematics screening and progress monitoring at first grade: Implications for responsiveness to intervention. *Exceptional Children, 73*, 311-330.

Fuchs, L.S., & Fuchs, D. (2002). Mathematical problem-solving profiles of students with mathematical disabilities with and without comorbid reading disabilities. *Journal of Learning Disabilities, 35*, 563 – 573.

Fuchs, L.S., Powell, S.R., Seethaler, P.M., Cirino, P.T., Fletcher, J.M., Fuchs, D., … & Zumeta, R.O. (2009). Remediating number combination and word problem deficits among students with mathematics difficulties: A randomized control trial. *Journal of Educational Psychology, 101*(3), 561 – 576.

Gaspard, H., Dicke, A-L., Flunger, B., Schreier, B., Häfner, I., Trautwein, U., & Nagengast, B. (2014). More value through greater differentiation: Gender differences in value beliefs about math. *Journal of Educational Psychology*. doi:http://psycnet.apa.org/doi/10.1037/edu0000003

Geary, D. (1994). *Children's mathematical development*. Washington, DC: American Psychological Association.

Geary, D. C. (1993). Mathematical Disabilities: Cognitive, Neuropsychological, and Genetic Components. *Psychological Bulletin, 114*(2), 345-362.

Geary, D., & Hoard, M. (2001). Numerical and arithmetical weaknesses in learning-disabled children: Relation to dyscalculia and dyslexia. *Aphasiology*, *15*(7), 635-647.

Georgiou, G. K., Torppa, M., Manolitsis, G., Lyytinen, H., & Parrila, R. (2012). Longitudinal predictors of reading and spelling across languages varying in

orthographic consistency. *Reading and Writing, 25*(2), 321-346.

Goetz, T., Cronjaeger, H., Frenzel, A. C., Ludtke, O., & Hall, N. C. (2010). Academic self-concept and emotion relations: Domain specificity and age effects. *Contemporary Educational Psychology, 35*(1), 44-58.

Guo, J., Marsh, H., Morin, A. J. S., Parker, P. D., & Kaur, G. (2015). Directionality of the associations of high school expectancy-value, aspirations, and attainment: A longitudinal study. *American Educational Research Journal, 52*(2), 371–402.

Guo, J., Marsh, H., Parker, P. D., Morin, A. J. S., & Yeung, A. S. (2015). Expectancy-value in mathematics, gender and socioeconomic background as predictors of achievement and aspirations: A multi-cohort study. *Learning and Individual Differences, 37*, 161–168.

Gurney, P. (1986). Self-esteem in the classroom: Theoretical perspectives and assessment issues. *School Psychology International, 7*, 199-209.

Guthrie, J. T., Hoa, A. L. W., Wigfield, A., Tonks, S. M., Humenick, N. M., & Littles, E. (2007). Reading motivation and reading comprehension growth in the later elementary years. *Contemporary Educational Psychology, 32*(3), 282-313.

Hakkarainen, A., Holopainen, L., & Savolainen, H. (2012). Mathematical and reading difficulties as predictors of school achievement and transition to secondary education. *Scandinavian Journal of Educational Research*, doi:10.1080/00313831.2012.696207

Hanich, L. B., Jordan, N. C., Kaplan, D., & Dick, J. (2001). Performance across different areas of mathematical cognition in children with learning difficulties. *Journal of Educational Psychology, 93*, 615-626.

Harter, S. (1982). The perceived competence scale for children. *Child Development, 53*, 87-97.

Harter, S. (1990). Processes underlying adolescent self-concept formation. In R. Montemayor, G. Adams, & T. Gullotta (Eds.), *From childhood to adolescence: A transitional period?* (pp. 205-239). Thousand Oaks, CA: Sage.

Hattie, J. A. (1992). *Self-concept.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Holopainen, L., Lappalainen, K., Junttila, N., & Savolainen, H. (2012). The role of social competence in the psychological well-being of adolescents in secondary education. *Scandinavian Journal of Educational Research, 56*(2), 199-212.

Inoue, Y. (1999). *The educational and occupational attainment process.* New York, NY: University Press of America.

Ireson, J., & Hallam, S. (2009). Academic self-concepts in adolescence: Relations with achievement and ability grouping in schools. *Learning and Instruction, 19*, 201–213.

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development, 73*, 509–527.

Jahnukainen, M. (2001). Two models for preventing students with special needs from dropping out of education in Finland. *European Journal of Special Needs Education, 16*(3), 245-258.

Janosz, M., LeBlanc, M., Boulerice, B., & Tremblay, R.E. (1997). Disentangling the Weight of School dropout predictors: A test on two longitudinal samples. *Journal of Youth and Adolescence, 26*(6), 733-762.

Janosz, M., LeBlanc, M., Boulerice, B., & Tremblay, R.E. (2000). Predicting different types of school dropouts: A typological approach with two longitudinal samples. *Journal of Educational Psychology, 92*(1), 171-190.

Järvinen, T., & Vanttaja, M. (2006). Koulupudokkaiden työurat [The Careers of

Students Dropping Out of School]. *Yhteiskuntapolitiikka, 71*(1), 14–22.

Järvinen, T., Vanttaja, M. (2001). Young people, education and work: Trends and changes in Finland in the 1990s. *Journal of Youth Studies, 4*(2), 195-207.

Jitendra, A. K., & Hoff, K. (1996). The effects of schema-based instruction on the word-problem-solving performance of students with learning disabilities. *Journal of Learning Disabilities, 29,* 421–431.

Jitendra, A. K., DiPipi, C. M., & Perron-Jones, N. (2002). An exploratory study of schema-based word-problem-solving instruction for middle school students with learning disabilities: An emphasis on conceptual and procedural understanding. *Journal of Special Education, 36,* 23–38.

Johansson, M-G. (2005). *LS. Handledning. Klassdiagnoser i läsning och skrivning för högstadiet och gymnasiet.* [LS. Manual. Diagnostics in reading and writing for middle school and upper secondary students]. M.-G. Johansson & Psykologiförlaget AB. Stockholm, Sweden: Psykologiförlaget.

Jordan, N. C., Hanich, L. B., & Kaplan, D. (2003). A longitudinal study of mathematical competencies in children with specific mathematics difficulties versus children with comorbid mathematics and reading difficulties. *Child Development, 74*(3), 843–850.

Kamins, M., & Dweck, C. S. (1999). Person vs. process praise and criticism: Implications for contingent self-worth and coping. *Developmental Psychology, 35*, 835–847.

Kaufmann, L., Wood, G., Rubinstein, O., & Henrik, A. (2011). Meta-Analyses of Developmental fMRI studies investigating typical and atypical trajectories of number processing and calculation. *Developmental Neuropsychology, 36*(6), 763-787.

Kirby, J. R., Georgiou, G. K., Martinussen, R., & Parrila, R. (2010). Naming speed and reading: From prediction to instruction. *Reading Research Quarterly, 45*(3), 341-362.

Kiuru, N., Aunola, K., Nurmi, J-E., Leskinen, E., & Savolainen, H. (2008). Peer group influence and selection in adolescents' school burnout: A longitudinal study. *Merrill-Palmer Quarterly, 54*, 23-55.

Kyttälä, M. (2008). Visuospatial working memeory in adolescents with poor performance in mathematics: variation depending on reading skills. *Educational Psychology, 28*, 273-289.

Lamb, S. (2011). Pathways to school completion: An international comparison. In S. Lamb, E. Markussen, R. Teese., N. Sandberg, & J. Polesel (Eds.), *School dropout and completion: International comparative studies in theory and policy* (pp. 21-73). London: Springer.

Landerl, K., Fussenegger, B., Moll, K., & Willburger, E. (2009). Dyslexia and dyscalculia: Two learning disorders with different cognitive profiles. *Journal of Experimental Child Psychology, 103*, 309-324.

Landerl, K., Ramus, F., Moll, K., Lyytinen, H., Leppänen, P. H. T., Lohvansuu, K., O´Donovan, M… Schulle-Körne, G. (2013). Predictors of developmental dyslexia in European orthographies with varying complexity. *Journal of Child Psychology and Psychiatry, 54*(6), 686-694.

LeFevre, J., Fast, L., Skwarchuk, S., Smith-Chant, B. L., Bisanz, J., Kamawar, D., et al. (2010). Pathways to mathematics: Longitudinal predictors of performance. *Child Development, 81*, 1753-1767.

Leung, S. A., Conoley, C. W., & Scheel, M. J. (1994). The career and educational aspirations of gifted high school students: A retrospective study. *Journal of Counseling and Development, 72*, 298–303.

Levin, H., Belfield, C., Muenning, P., & Rouse, C. (2007). *The costs and benefits of an excellent education for all of America´s*

children. New York, NY: Teachers College Press.

Light, G. J., & De Fries, J. C. (1995). Comorbidity of reading and mathematical disabilities: Genetic and environmental etiologies. *Journal of Learning Disabilities, 28*(2), 96–106.

Linsen, S., Torbeyns, J., Verschaffel, L., Reynvoet, B., & De Smedt, B. (2016). The association between symbolic and nonsymbolic numerical magnitude processing and mental versus algorithmic subtraction in adults. *Acta Psychologia, 165,* 34-42.

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika, 88*, 767–778.

Luttrell, V. R., Callen, B. W., Allen, C. S., Wood, M. D., Deeds, D. G., & Richard, D. C. S. (2010). The mathematics value inventory for general education students: Development and initial validation. *Educational and Psychological Measurement, 70*, 142–160.

Lyons, I. M., Price, G. R., Vaessen, A., Blomert, L., Ansari, D. (2014). Numerical predictors of arithmetic success in grades 1–6. *Developmental Science, 17*(5), 714-726.

Mahaffy, K., & Ward, S. (2002). The gendering of adolescents' childbearing and educational plans: Reciprocal effects and the influence of social context. *Sex Roles, 46*, 403–417.

Marsh, H. W. (1986). Verbal and math self-concepts: An internal/external frame of reference model. *American Educational Research Journal, 23*, 129–149.

Marsh, H. W. (1987). The big-fish-little-pond effect on academic self-concept. *Journal of Educational Psychology, 79,* 280-295.

Marsh, H. W., & Craven, R. G. (1997). Academic self-concept: Beyond the dustbowl. In G. D. Phye (Ed.), *Handbook of classroom assessment: Learning, achievement, and adjustment, Educational psychology series* (pp. 131-198). San Diego, CA: Academic Press.

Marsh, H. W., & Craven, R. G. (2002). The pivotal role of frames of reference in academic self-concept: The "big-fish-little-pond" effect. In F. Pajares & T. Urdan (Eds.), *Adolescence and education: Vol. 2. Academic motivation of adolescents.* Greenwich, CT: Information Age Publishing.

Marsh, H. W., Hau, K. T., & Kong, C-K. (2002). Multilevel causal ordering of academic self-concept and achievement: Influence of language of instruction (English compared with Chinese) for Hong Kong students. *American Educational Research Journal, 39*(3), 727-763.

Marsh, H. W., Hau, K. T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. *Multivariate Behavioral Research, 33*, 181–220.

Marsh, H. W., Seaton, M., Trautwein, U., Lüdtke, O., Hau, K.T., O'Mara, A.J., & Craven, R.G. (2008). The big-fish-little-pond effect stands up to critical scrutiny: Implications for theory, methodology, and future research. *Educational Psychology Review, 3*, 319-350.

Marsh, H. W., Tracey, D., & Craven, R. (2006). Multidimensional self-concept structure for preadolescents with mild intellectual disabilities: A hybrid multigroup –MIMC approach to factorial invariance and latent mean differences. *Educational and Psychological Measurement, 66*(5), 795-818.

Marsh, H., Hau, K. T., & Wen, Z. (2004). In search for golden rules: Comment on the hypothesis testing approaches to setting cutoff values for fit indexes and dangers in overgeneralising Hu & Bentler's (1999) findings. *Structural Equation Modeling, 11*, 320–341.

Marsh, H.W., Abdulkabbar, A. S., Parker, P. D., Morin, A. J. S., Abdelfattah, F., Nagengast, B., Möller, J., & Abu-Hilal, M. M. (2015). The internal/external frame of reference model of self-concept and achievement relations: Age-cohort and cross-cultural

differences. *American Educational Research Journal, 52*(1), 168-202.

Mau, W. C., & Bikos, L. H. (2000). Educational and vocational aspirations of minority and female students: A longitudinal study. *Journal of Counseling & Development, 78*, 186–194.

Mazzocco, M. M. M. (2007). Defining and differentiating mathematical learning disabilities and difficulties. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 49–60). Baltimore, MD: Brookes.

Mazzocco, M. M. M., & Myers, G. F. (2003). Complexities in Identifying and Defining Mathematics Learning Disability in the Primary School-Age Years. *Annals of Dyslexia, 53*, 218-253.

Mazzocco, M. M. M., & Räsänen, P. (2013). Contributions of longitudinal studies to evolving defnitions and knowledge of developmental dyscalculia. *Trends in Neuroscience and Education, 2*, 65-73.

Mazzocco, M. M. M., Feigenson, L., & Halberda, J. (2011). Impaired acuity of the approximate number system underlies mathematical learning disability (dyscalculia). *Child Development, 82*, 1224–1237.

McArdle, J. J., & Nesselroade, J. R. (2014). *Longitudinal data analysis using structural equation models*. Washington, DC, USA: American Psychological Association.

Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology, 44*, 351–373.

Mejias, S., Grégoire, J., & Noël, M-P. (2012). Numerical estimation in adults with and without developmental dyscalculia. *Learning and Individual Differences, 22*(1), 164-170.

Mendez, L. M. R., & Crawford, K. M. (2002). Gender-role stereotyping and career aspirations: A comparison of gifted early adolescent boys and girls. *Journal of Secondary Gifted Education, 13*, 96–107.

Merkel, R., & Ansari, D. (2016). Why numerical symbols count in the development of mathematical skills: evidence from brain and behavior. *Current Opinion in Behavioral Sciences, 10*, 14-20.

Möller, J., Pohlman, B., Köller, O., & Marsh, H. W. (2009). A meta-analytic path analysis of the internal/external frame of reference model of academic achievement and academic self-concept. *Review of Educational Research, 79*(3), 1129-1167.

Murayama, K., Pekrun, R., Lichtenfeld, S., & vom Hofe, R. (2012). Predicting long-term growth in students' mathematics achievement: The unique contributions of motivation and cognitive strategies. *Child Development, 84*(4), 1475-1490.

Muthén, L. K., & Muthén, B. O. (1998–2011). *Mplus user's guide (6th ed.)*. Los Angeles, CA: Muthén & Muthén.

Nagengast, B., & Marsh, H. W. (2011). The negative effect of school-average ability on science self-concept in the UK, the UK countries and the world: The big-fish-little-pond effect for PISA 2006. *Educational Psychology, 31*(5), 629-656.

Nagy, G., Trautwein, U., Baumert, J., Köller, O., & Garrett, J. (2006). Gender and course selection in upper secondary education: Effects of academic self-concept and intrinsic value. *Educational Research and Evaluation: An International Journal on Theory and Practice, 12*(4), 323–345.

Nurmi, J.-E., & Salmela-Aro, K. (2002). Goal construction, reconstruction and depressive symptoms in a life-span context: The transition from school to work. *Journal of Personality, 70,* 385–420.

Nyqvist, F., Finnäs, F., Jakobsson, G, & Koskinen, S. (2008). The effect of social capital on health: The case of two language groups in Finland. *Health & Place, 14*(2), 347-360.

Nyyssölä, K. (2004). Siirtymävaiheiden koulutusvalinnat—koulutuspoliittinen tarkastelu [Educational choices in transition—perspective of educational policy]. *Kasvatus, 35*, 222–229.

O'Mara, A. J., Marsh, H. W., Craven, R. G., & Debus, R. L. (2006). Do self-concept interventions make a difference? A synergistic blend of construct validation and meta-analysis. *Educational Psychologist, 41*(3), 181–206.

OECD (2003). *Student engagement at school: A sense of belonging and participation*. Paris: OECD.

OECD. (2010). *PISA 2009 results: What students know and can do: Student performance in reading, mathematics and science*. Paris: Author.

Official Statistics of Finland (2012a). *Population structure* [e-publication]. ISSN=1797-5395. Helsinki: Statistics Finland [referred: 13.10.2012]. Access method: http://www.stat.fi/til/vaerak/index_en.html.

Official Statistics of Finland (2012b). *Discontinuation of education* [e-publication]. ISSN=1798-9302. Helsinki: Statistics Finland [referred: 13.10.2012]. Access method: http://www.stat.fi/til/kkesk/index_en.html.

Olsson, L., Östergren, R., & Träff, U. (2016). Developmental dyscalculia: A deficit in the approximate number system or an access deficit? *Cognitive Development, 39*, 154-167.

Ostad, S. (1998). Comorbidity between mathematics and spelling difficulties. *Logopedics Phoniatrics Vocology (Log Phon Vocol), 23*(4), 145-154.

Otis, N., Grouzet, M. E., & Pelletier, L. C. (2005). Latent motivational change in an academic setting: A 3-year longitudinal study. Journal of Educational Psychology, 97, 170–183.

Owens, J. (2004). *A review of the social and non-market returns to education*. Wales, UK: Education and Learning Network.

Parker . P., Nagy, G., Trautwein, U., Lüdtke, O. (2014). Predicting career aspirations and university majors from academic ability and self-concept: a longitudinal application of the internal–external frame of reference model. In I. Schoon, & J. S. Eccles (Eds.), *Gender Differences in Aspirations and Attainment: A Life Course Perspective* (pp. 224–246). Cambridge: University Press.

Parker, P. D., Schoon, I., Tsai, Y.-M., Nagy, G., Trautwein, U., & Eccles, J. S. (2012). Achievement, agency, gender, and socioeconomic background as predictors of postschool choices: A multicontext study. *Developmental Psychology*, *48*(6), 1629 – 1642.

Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315–329.

Piazza, M. (2010). Neurocognitive start-up tools for symbolic number representations. *Trends in Cognitive Science, 14*(12), 542-551.

Pickering, S. J., & Gathercole, S. E. (2004). Distinctive working memory profiles in children with special educational needs. *Educational Psychology, 24*, 393-408.

Pollard, E.L., & Lee, P.D. (2003). Child well-being: A systematic review of the literature. *Social Indicator Research, 61*(1), 59–78.

Price, G. R., Holloway, I., Räsänen, P., Vesterinen, M., & Ansari, D. (2007). Impaired parietal magnitude processing in developmental dyscalculia. *Current Biology, 17*, R1042–R1043.

Ramus, F. (2004). Neurobiology of dyslexia: A reinterpretation of the data. *Trends in Neuroscience, 27*(12), 720-726.

Räsänen, P., & Leino, L. (2005). *KTLT. Laskutaidon testi. Opas yksilö- tai ryhmämuotoista arviointia varten* [KTLT. Arithmetic skills test. Manual for individual or group assessment]. Jyväskylä, Finland: NMI.

Renninger, K. A. & Su, S. (2012). Interest and its development. In R. Ryan (Ed.), *The Oxford*

handbook of human motivation (pp. 167–187). New York: Oxford University Press.

Renninger, K. A., & Hidi, S. (2011). Revisiting the conceptualization, measurement and generation of interest. *Educational Psychologist, 46*(3), 168–184.

Retelsdorf, J., Köller, O., & Möller, J. (2014). Reading achievement and reading self-concept – Testing the reciprocal effects model. *Learning and Instruction, 29*, 21-30.

Rimpelä, M. (2003). Kouluterveyskysely [Questionnaire for school health] [referred: 6.11.2012]. Access method: http://info.stakes.fi/kouluterveyskysely/EN/index.htm

Rinne, R., & Järvinen, T. (2011). Dropout and completion in upper secondary education in Finland. In S. Lamb, E. Markussen, R. Teese., N. Sandberg, & J. Polesel (Eds.), *School dropout and completion: International comparative studies in theory and policy* (pp. 215-232). London: Springer.

Rojewski, J. W. (2005). Occupational aspirations: Constructs, meanings, and applications. In S. D. Brown, & R. W. Lent (Eds.), *Career development and counselling: Putting theory and research to work* (pp. 131-154). Hoboken, NJ: Wiley.

Rotzer, S., Loenneker, T., Kucian, K., Martin, E., Klaver, P., & von Aster, M. Dysfunctional neural network of spatial working memory contributes to developmental dyscalculia. *Neuropsychologia, 47*(13), 2859-2865.

Rourke, B. P., & Conway, J. A. (1997). Disabilities of arithmetic and mathematical reasoning: Perspectives from neurology neuropsychology. *Journal of Learning Disabilities, 30*(1), 34-46.

Rubinsten, O., & Henik, A. (2009). Developmental dyscalculia: heterogeneity might not mean different mechanisms. *Trends in Cognitive Science 13*, 92–99.

Rueger, S.Y., Malecki, C.K., & Demaray, M.K. (2010). Relationship between multiple sources of peceived social support and psychological and academic adjustment in early adolescence: Comparisons across gender. *Journal of Youth and Adolescence, 39*(1), 47–61.

Rumberger, R. W., & Lamb, S. P. (2003). The early employment and further education experiences of high school dropouts: A comparative study of the United States and Australia. *Economics of Education Review*, 22, 353-366.

Saarela, J., & Finnäs, F. (2003). Unemployment and native language: The Finnish case. *The Journal of Socio-Economics, 32*(1), 59-80.

Salmela-Aro, K., & Näätänen, P. (2005). *Method of assessing adolescents´ school burnout* [in Finnish]. Helsinki, Finland: Edita.

Salmela-Aro, K., & Tynkkynen, L. (2012). Gendered pathways in school burnout among adolescents. *Journal of Adolescence, 35*(4), 929–939.

Salmela-Aro, K., & Upadyaya, K. (2014a). The demands–resources model in school context. *British Journal of Educational Psychology, 84*,137–151.

Salmela-Aro, K., & Upadyaya, K. (2014b). Developmental trajectories of school burnout: Evidence from two longitudinal studies. *Learning and Individual Differences, 36*, 60–68.

Salmela-Aro, K., Kiuru, N., & Nurmi, J-E. (2008). The role of educational track in adolescents' school burnout: A longitudinal study. *British Journal of Educational Psychology, 78*(4), 663–689.

Salmela-Aro, K., Kiuru, N., Leskinen, E., & Nurmi, J-E. (2009). School burnout inventory (SBI): Reliability and validity. *European Journal of Psychological Assessment, 25,* 48–57

Salmela-Aro, K., Savolainen, H., & Holopainen, L. (2009). Depressive symptoms and school burnout during adolescence: Evidence from two cross-lagged longitudinal studies. *Journal of Youth and Adolescence, 38*(10), 1316-1327.

Savolainen, H. (2001*). Explaining mechanisms of educational career choice. A follow-up study of the educational choices of a group of youths that finished compulsory education in 1990.* University of Joensuu. Publications in education, 69.

Savolainen, H., Ahonen, T., Aro, M., Tolvanen, A., & Holopainen, L. (2008). Reading comprehension, word reading and spelling as predictors of school achievement and choice of secondary education. *Learning and Instruction, 18*, 201–210.

Schaufeli, W., & Bakker, A. (2004). Job demands, job resources and their relationship with burnout and engagement; a multi-sample study. *Journal of Organizational Behavior, 25*, 293–299.

Schneider, M., Beeres, K., Coban, L., Merz, S., Schmidt, S., Stricker, J., & De Smedt, B. (2016). Associations of non-symbolic and symbolic numerical magnitude processing with mathematical competence: a meta-analysis. *Developmental Science*. doi: 10.1111/desc.12372

Shafrir, U. & Siegel, L. S. (1994). Subtypes of Learning Disabilities in Andolescents and Adults. *Journal of Learning Disabilities, 27*(2), 123-134

Shalev, R. S. (2007). Prevalence of developmental dyscalculia. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 49–60). Baltimore, MD: Brookes.

Shapka, J. D., Domene, J. F., & Keating, D. P. (2006). Trajectories of career aspirations through adolescence and young adulthood: Early math achievement as a critical filter. *Educational Research and Evaluation, 12*(4), 347–358.

Shaywitz, B. A., Shaywitz, S. E., Pugh, K. R., Menci, W. E., Fulbright, R. K., Skudlarski, P., Constable, R. T… Gore, J. C. (2002). Disruption of posterior brain systems for reading in children with developmental dyslexia. *Biological Psychiatry, 52*(2), 101-110.

Siegel, L. S., & Ryan, E. B. (1989). The development of working memory in normally achieving and subtypes of learning disabled children. *Child Development, 60*, 973-980.

Simmons, F. R., & Singleton, C. (2008). Do weak phonological representations impact on arithmetic development? A review of research into arithmetic and dyslexia. *Dyslexia, 14*, 77–94.

Simola, H., Rinne, R., & Kivirauma, J. (1999). Finland. National changes in education and education governance, In S. Lindblad & T. Popkewitz (Eds.), *Education governance and social integration and exclusion: National cases of educational systems and recent reforms* (pp. 42-64). Uppsala: Uppsala Univeristy.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417-453.

Skagerlund, K., & Träff, U. (2014). Number processing and heterogeneity of developmental dyscalculia: Subtypes with different cognitive profiles and deficits. *Journal of Learning Disabilities*. doi: 10.1177/0022219414522707

Snowling, M. J. (2005). The science of dyslexia: A review of contemporary approaches. In M. Turner & J. Rack (Eds.), *The Study of Dyslexia* (pp. 77-90). New York: Springer.

Steyer, R., Partchev, I., & Shanahan, M. J. (2000). Modeling true intraindividual change in structural equation models: The case of poverty and children's psychosocial adjustment. In T. D. Little, K. U. Schnabel, & J. Baumert (Eds.), *Modeling longitudinal and multilevel data: Practical issues, applied approaches, and specific examples* (pp. 109-126). Mahwah, NJ: Erlbaum.

Stock, P., Desoete, A., & Roeyers, H. (2010). Detecting children with arithmetic disabilities from kindergarten: Evidence

from a 3-year longitudinal study on the role of preparatory arithmetic abilities. *Journal of Learning Disabilities, 43*(3), 250-268.

Sum, A., Khatiwada, I., McLaughlin, J., & Palma, S. (2009). *The consequences of dropping out of high school*. Boston, MA: Center for Labor Market Studies.

Swanson, H. L., & Beebe-Frankenberger, M. (2004). The Relationship Between Working Memory and Mathematical Problem Solving in Children at Risk and Not at Risk for Serious Math Difficulties. *Journal of Educational Psychology, 96*(3), 471-491.

Swanson, H. L., Jerman, O., & Zheng, X. (2009). Math disabilities and reading disabilities: Can they be separated? *Journal of Psychoeducational Assessment, 27*(3), 175-196.

Toll, S. W. M., Kroesbergen, E. H., & Van Luit, J. E. H. (2016). Visual working memory and number sense: Testing the double deficit hypothesis in mathematics. *British Journal of Educational Psychology*. doi: 10.1111/bjep.12116

Träff, U. (2013). The contribution of general cognitive abilities and number abilities to different aspects of mathematics in children. *Journal of Experimental Child Psychology, 116*(2), 139-156.

Trebbels, M. (2015). *The transition at the end of compulsory full-time education: Educational and future career aspirations of native and migrant students*. Wiesbaden: Springer.

Tuominen-Soini, H., & Salmela-Aro, K. (2014). Schoolwork engagement and burnout among Finnish high school students and young adults: Profiles, progressions, and educational outcomes. *Developmental Psychology, 50*(3), 649–662.

Tuominen-Soini, H., Salmela-Aro, K., & Niemivirta, M. (2008). Achievement goal orientations and subjective well-being: A person-centred analysis. *Learning and Instruction, 18*, 251-266.

Tuominen-Soini, H., Salmela-Aro, K., & Niemivirta, M. (2012). Achievement goal orientations and academic well-being across the transition to upper secondary education. *Learning and Individual Differences, 22*, 290-305.

Valentine, J., DuBois, D., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist, 39*(2), 111-133.

Van Petegem, K., Aelterman, A., Rossel, Y., & Creemers, B. (2007). Students' perceptions as moderator for students' wellbeing. *Social Indicators Research, 83*(3), 447–463.

Vanbinst, K., Ansari, D., Ghesquiere, P., De Smedt, B. (2016). Symbolic numerical magnitude processing is as important to arithmetic as phonological awareness is to reading. *PLoS ONE, 11*(3), e0151045.

Vanttaja, M., & Järvinen, T. (2004). Koulutuksesta ja työstä karsiutuneet: Vailla ammattitutkintoa ja työpaikkaa vuonna 1985 olleiden nuorten myöhemmät elämänvaiheet [Excluded from Education and Work: Young People with Neither a Degree Nor a Job in 1985 and Their Later Stages of Life]. *Yhteiskuntapolitiikka, 69(*5), 472–480.

Vasalampi, K., Salmela-Aro, K., & Nurmi, J-E. (2009). Adolescents' self-concordance, school engagement, and burnout predict their educational trajectories. *European Psychologist, 14*(4), 332–341.

Vasalampi, K., Salmela-Aro, K., & Nurmi, J-E. (2010). Education-related goal appraisals and self-esteem during the transition to secondary education: A longitudinal study. *International Journal of Behavioral Development, 34*(6), 481-490.

Vellutino, F. R., & Fletcher, J. M. (2005). Developmental dyslexia. In M. J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 362-378). Malden: Blackwell Publishing.

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): what have we learned in

the past four decades? *The Journal of Child Psychology and Psychiatry, 45*(1), 2-40.

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

Viljaranta, J., Nurmi, J.-E., Aunola, K., & Salmela-Aro, K. (2009). The role of task values in adolescents' educational tracks: A person-oriented approach. *Journal of Research on Adolescence, 19*, 786–798.

von Eye, A., Spiel, C., & Wood, P. K. (1996). Configural frequency analysis in psychological research. *Applied Psychology, 45*(4), 301-352.

Vukovic, R. K., & Lesaux, N. K. (2013a). The relationship between linguistic skills and arithmetic knowledge. *Learning and Individual Differences, 23*, 87-91.

Vukovic, R. K., & Lesaux, N. K. (2013b). The language of mathematics: Investigating the ways language counts for children´s mathematical development. *Journal of Experimental Child Psychology, 115*, 227-244.

Vukovic, R. K., Lesaux, N. K., & Siegel, L. S. (2010). The mathematics skills of children with reading difficulties. *Learning and Individual Differences, 20*, 639-643.

Watt, H. M. (2005). Exploring adolescent motivations for pursuing maths-related careers. *Australian Journal of Educational and Developmental Psychology, 5*, 107–116.

Watt, H. M., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., & Eccles, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: A comparison of samples from Australia, Canada, and the United States. *Developmental Psychology, 48*(6), 1594–1611.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review, 12*, 1–46.

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68–81.

Wilson, V. L. & Rupley W. H. (2013) Design for learning disabilities experimental and quasi-experimental research. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* 2nd ed. (pp. 593–606). New York, NY: The Guilford Press.

Wise, J. C., Kyeong Pae, H., Wolfe, C. B., Sevcik, R. A., Morris, R. D., Lovett, M., & Wolf, M. (2008). Phonological Awareness and Rapid Naming Skills of Children with Reading Disabilities and Children with Reading Disabilities Who Are At Risk for Mathematics Difficulties. *Learning Disabilities Research & Practice, 23*(3), 125-136.

Zeleke, S. (2004). Self-concepts of students with learning disabilities and their normally achieving peers: A review. *European Journal of Special Needs Education, 19*(2), 145–170.

ISBN 978-952-12-3463-7