Learning Difficulties as Predictors for Dropping out of Upper Secondary Education

Julia Partio

Master's Thesis in Development, Education and International Cooperation
Article-based
Autumn Term 2023
Faculty of Education and Psychology
University of Jyväskylä

ABSTRACT

Partio, Julia. 2023. Learning difficulties as predictors for Dropping out of Upper Secondary Education. Master's Thesis in Development, Education and International Cooperation [Education]. University of Jyväskylä. Faculty of Education and Psychology. 44 pages.

Dropping out of education is connected to many negative outcomes on individual and societal level. The purpose of this study was to investigate to what extent learning difficulties measured in the 9th grade predict dropping out of upper secondary education and whether that connection is moderated by family´s socioeconomic background.

The data used in this study is from the First Steps follow-up study (Lerkkanen et al. 2006–2016) and its extension, the School Path: From First Steps to Secondary and Higher Education study (Vasalampi and Aunola 2016–2020). Participants´ (n=1476) mathematical skills and reading skills were tested in the ninth grade in the spring 2016. In 2019 the information about graduation of upper secondary education was collected from the school registers. The data was analysed through logistic regression analysis.

This longitudinal study showed that learning difficulties in reading and mathematics predict dropping out of upper secondary education. Results showed that reading comprehension did predicted dropping out of upper secondary education, but technical reading skills were not connected to dropping out. Difficulties in arithmetic skills was found to be the strongest predictor of dropping out as the connection between arithmetic skills and dropping out of education remained significant after including socioeconomic background in the analysis. Results found in this study offer valuable information for education practitioners as well as for improving education systems towards prevention of upper secondary school dropouts.

Keywords: dropout, mathematics, reading, learning difficulties, upper secondary education

TIIVISTELMÄ

Partio, Julia. 2023. Oppimisvaikeudet toisen asteen koulutuksen keskeyttämisen ennustajina. Englanninkielisen pro gradu -tutkielman suomenkielinen tiivistelmä. Jyväskylän yliopisto. Kasvatustieteiden ja psykologian tiedekunta. 44 sivua.

Koulutuksen keskeyttämiseen liittyy monia kielteisiä seurauksia yksilön ja yhteiskunnan tasolla. Tämän tutkimuksen tarkoituksena oli tutkia, missä määrin 9. luokalla mitatut oppimisvaikeudet sekä perheen sosioekonominen tausta ennustavat toisen asteen koulutuksen keskeyttämistä.

Tässä tutkimuksessa käytetty aineisto on peräisin Kouluportaat-seurantatutkimuksesta (Lerkkanen ym. 2006-2016) ja sen laajennuksesta, Koulupolku: Alkuportailta jatko-opintoihin -tutkimuksesta (Vasalampi ja Aunola 2016-2020). Osallistujien (n=1476) matemaattisia taitoja ja lukutaitoa testattiin yhdeksännellä luokalla keväällä 2016. Vuonna 2019 koulurekisteristä kerättiin tieto toisen asteen tutkinnon suorittamisesta. Analysointimenetelmänä käytettiin logistista regressioanalyysia.

Tämä pitkittäistutkimus osoittaa, että lukemisen ja matematiikan oppimisvaikeudet ennustavat toisen asteen koulutuksen keskeyttämistä. Tulosten mukaan heikot luetun ymmärtämisen taidot ennustivat toisen asteen koulutuksen keskeyttämistä, mutta tekninen lukutaito ei ollut yhteydessä opintojen keskeyttämiseen. Haasteet aritmeettisissa taidoissa ennustivat voimakkaimmin toisen asteen opintojen keskeyttämistä, sillä aritmeettisten taitojen ja toisen asteen koulutuksen keskeyttämisen välinen yhteys säilyi merkitsevänä myös sen jälkeen, kun sosioekonominen tausta oli otettu huomioon.

Asiasanat: koulupudokkuus, matematiikka, lukutaito, oppimisvaikeudet, toisen asteen koulutus

CONTENTS

ABSTRACT **2**

TIIVISTELMÄ **3**

CONTENTS **4**

1 INTRODUCTION **5**

1.1 Dropping out of upper secondary education 7

1.2 Reading difficulties 8

1.3 Mathematical learning difficulties 9

1.4 Learning difficulties and dropping out of upper secondary education 11

1.5 Socioeconomic background and dropping out of upper secondary education 12

1.6 Research problem 13

2 RESEARCH METHODS **15**

2.1 Research Data 15

2.2 Measurements 15

2.3 Data Analysis 18

2.3.1 Logistic regression analysis 19

2.3.2 Testing the equality of two coefficients 20

3 RESULTS **22**

3.1 Descriptive statistics 22

3.2 Learning difficulties predicting dropping out of upper secondary education 23

3.3 Learning difficulties and socioeconomic background as predictors of dropping out of upper secondary education 24

4 DISCUSSION 29

4.1 Limitations and future research 32

4.2 Ethical consideration and practical implications 34

REFERENCES 36

1 INTRODUCTION

Dropping out of upper secondary education is an issue that has far-reaching effects on an individual's life as well as the whole society. Dropping out of upper secondary education substantially increases the risks of being unemployed in the future (Huttunen & Pekkarinen, 2016), which on a societal level has many effects, such as rise of government expenses and increased risk for community related issues such as substance abuse and exclusion (Patrick et al., 2016). Additionally, the level of education is connected to health (Zajacova & Lawrence, 2018) as higher levels of education have been found to be associated with generally better health and healthier lifestyle (Böckerman & Maczulskij, 2016) as well as lower levels of mental health issues (Halpern-Manners, Schnabel & Hernandez, 2016). Also, previous studies have shown evidence of a connection between education and crime (Hjalmarsson et al., 2015, Huttunen et al., 2023). A Swedish study investigated the causal effect of educational attainment on conviction and imprisonment. The results indicated that one additional school year decreases the likelihood of conviction by almost 7% and imprisonment by nearly 16% (Hjalmarsson et al., 2015). Furthermore, a recent study conducted in Finland implicates that among young men, attending any upper secondary school reduces the risk of committing crimes and the effect can be seen ten years after first attending to upper secondary education (Huttunen et al., 2023). Overall, the results of studies investigating the effects of education suggest, that by increasing participation in education, criminal behaviour can be reduced (Suonpää et al., 2023).

School dropouts are associated with a variety of problems that affect students´ school paths. Comprehensive understanding about the core issues is a prerequisite for reducing permanent school dropouts. Research results have shown that there are many risk factors for dropping out of school, such as low education level of the parents, single parenthood or learning disabilities (Nurmi, 2011). According to a survey in 2020 funded by the Finnish National Agency for

Education, there are at minimum 4000 students in Finland that have major challenges in attending the lower secondary school, and therefore are at risk of dropping out. Among the lower secondary school students who were at risk of dropping out, around 40% had learning difficulties such as difficulties in reading and writing. This percentage implies that learning difficulties were more common with students that were at risk of dropping out as approximately 4-10% of typical lower secondary school students have learning difficulties. Moreover, most of the students who were at risk of dropping out received special education in school (Määttä et al., 2020).

The aim of this study is to gain knowledge about the connections between learning difficulties and dropping out of upper secondary education. Objective of this study is to investigate, whether learning difficulties measured in 9th grade predict dropping out of upper secondary education. This study focuses on difficulties in mathematics and reading, as these skills form the foundation for academic achievement (Hakkarainen et al., 2013). Furthermore, the aim is to investigate whether socioeconomic background effects on the connection between learning difficulties and school dropouts.

This study is also very relevant now as in 2021 The Act of Compulsory Education was reformed in Finland, and The Finnish Government raised the compulsory education age to 18 years. This means that after 9 years of basic education students are obligated to attend general upper secondary school, vocational upper secondary education or to study a double degree, which consists of vocational qualification and a matricular examination (Ministry of Education and Culture, 2023). This reform poses new challenges to educational institutions to meet the needs of the students, especially the ones that require support for learning and are at risk of dropping out of education. Therefore, investigating the connections between educational dropouts and learning difficulties is relevant, as more knowledge is needed about the specific risk factors to develop educational programs that aim to prevent upper secondary school dropouts.

1.1 Dropping out of upper secondary education

There are many different definitions for dropping out of education and the definition may vary depending on the education system in question. Dropping out of school refers to a situation, where student has not finished a certain level of education and do not finish the degree during the compulsory education age. Depending on the context, dropping out of school can refer not completing lower secondary education or upper secondary education. Also, a term *early school leaver* is used when referring to a person who has dropped out of education. According to European Commission (2022), early school leaver refers to a person aged 18-24 who has dropped out of education before completing lower secondary education or has lower secondary education degree but has not proceed to further education. On the other hand, young people that have not completed upper secondary education and are not employed can be referred as dropped out of education (Järvinen & Vanttaja, 2013). This explanation is very close to the definition of NEET (Not in Employment, Education or Training), which is used of a young person (aged 15-24) who is not in education, working or performing a military service (Eskelinen, 2020). Because the definitions are so varied, it is very challenging to estimate the prevalence of upper secondary school dropouts (Estevao & Alvares, 2014).

Due to the Finnish context this study uses the definition of school dropout by Statistics Finland. According to Statistics Finland (2023) students who dropout refers to compulsory school aged students who stop going to school before completing compulsory education (those who have completely neglected their compulsory education) or who do not complete the entire curriculum during compulsory education (those who have finished compulsory school without a certificate). The data for this study was collected before the reformation of the Act of Compulsory education (between years 2016-2020), when students were not obligated to attend upper secondary education and the compulsory school age was 16.

The drop-out rate in upper secondary education was 6.8% in the year 2019-2020 (Statistics Finland, 2022). However, dropout-rate in vocational education is increasing. In the school year 2018-2019 the drop-out rate was 9.4% (Statistics Finland, 2022) while in 2019-2020 the drop-out rate rose in vocational education to 13,3% (Statistics Finland, 2022). This data shows that there is a substantial increase in the drop-out rate in vocational education as the rate increased by 3.9 percentage points from the previous year.

There are approximately 54 000 young people (aged 20-24) in Finland who have only finished basic education (primary and lower secondary education) (Statistics Finland, 2021a). In the year 2021 there were approximately 45 000 young people (aged 15-24) who are not in education, working or performing a military service, which covers around 7% of the age group. Most of them, 33 000, were aged 20-24 (Eskelinen, 2020).

Furthermore, there are gender differences in the statistics of dropping out of upper secondary school. According to OECD (2020), in 2018 in Finland 8% of women had not finished an upper secondary education, while for men the percentage was 11. It has been reported previously that the drop-out rates among boys are relatively higher compared to girls (OECD, 2020).

1.2 Reading difficulties

Difficulties in reading affect academic performance and they usually are very persistent (Undheim, 2009). Technical reading refers to the basic ability to combine sounds and syllables (decoding) and word recognition skills (Siiskonen, 2010). Languages that have consistent orthographies (where each letter corresponds to phoneme), such as Finnish, problems with reading fluency relates to insufficient technical reading skills, which also makes reading very slow (Siiskonen, 2010). The ability to decode is also known to be a predictor of reading comprehension with languages that do not have consistent letter-sound relation (Keenan et al., 2008). In consistent orthographies, decoding ability does not play such an important part in reading comprehension, and other factors such as oral

language skills might predict reading comprehension better (Caravolas et al., 2019). Technical reading and reading comprehension are two different skills, that usually occur together, but this is not the case always (Aro et al., 2008). Slow speed of reading and multiple errors make reading challenging, but the reader´s reading comprehension skills may still be good.

Fluent reading comprehension requires many different cognitive processes, and these processes can be divided to lower-lever processes and higher-level processes. Decoding, vocabulary knowledge and reading fluency are categorized as lower-level processes, and they form a base for reading skills (Jakobson,2022). Higher-level processes such as cognitive control, inference-making skills (Kendeou et al., 2014), visualizing, memorizing and elaborating (e.g., activating mental representations, predicting) (Strømsø et al., 2003) are processes that combine the words and syllables to meaningful mental representations (Jakobson et al., 2022). These higher-level processes are monitored by executive functions, such as working memory and inhibition (Kendeou et al., 2014). Difficulties in reading comprehension can be caused by deficits in lower -or higher lever processes, and usually there is not only one specific reason for difficulties in reading comprehension.

Term "reading difficulties" is used when student has difficulties in one or more of the domains: technical reading, reading comprehension and writing (Panula, 2013). Reading difficulties cover a wide category of deficits in reading skills, that affect overall performance in reading and writing. Therefore, term *reading difficulties* is used in this study, as this study does not focus on a specific reading disability. Specifically, this study focuses on *difficulties in technical reading skills* and *difficulties in reading comprehension*.

1.3 Mathematical learning difficulties

Mathematical learning difficulties are quite common as approximately 3−7% of the age group has difficulties in basic mathematical skills (Niilo Mäki Institute, 2023). Mathematics include many different subskills such as arithmetic,

geometry or algebra, but usually the foundation for other skills is built on arithmetic skills (Aunola et al., 2004; Mazzocco & Thompson, 2005). Difficulties can be due to deficits in different cognitive processes (such as working memory, attention, or visual-spatial processing) (Fusch et al., 2005; Swanson & Beebe-Frankenberger, 2004), the speed of processing and challenges in learning sufficient counting strategies (Geary, 2011; Nelson & Powell, 2018). These challenges are very persistent, as previous studies have shown that mathematical learning difficulties persist throughout primary school (Jordan et al., 2002; Shalev et al., 2005). Furthermore, lack of basic mathematical skills, such as arithmetical skills, further makes learning of more complicated mathematical tasks (e.g. math word problems) and higher mathematical thinking (e.g. algebra, geometry) difficult (Salihu & Räsänen, 2018), as mathematical skills are taught and learned hierarchically (Aunola et al., 2004).

Term *mathematical learning difficulties* refer to deficit in mathematical skills that affect to everyday life in those situations when any type of mathematical knowledge or skill is required. Term *mathematical disability* is used in research literature to refer the most persistent and severe deficits in mathematical skills, and it usually refers to specific, diagnosed disability, such as dyscalculia (Mazzocco, 2007). However, many students have challenges with mathematics without a disability diagnosis. In research literature term *mathematical difficulties* is used to refer to students performing low in mathematical skills as well as students that are diagnosed with math disability (Nelson & Powell, 2018). Furthermore, *mathematical learning difficulties* refer to any deficit in mathematical skills, as there is not only one type of mathematical difficulties (Mononen et al., 2017). In this research, term *mathematical learning difficulty* is used, as this study does not focus on specific mathematical disability.

Students with mathematical learning difficulties consistently perform poorly in counting, computation, problem solving and use of retrieval strategies (Nelson & Powell, 2018). These skills are essential in everyday life. The effects of mathematical learning difficulties are visible as poor mathematical skills can reduce employment opportunities even more than poor reading skills (Geary,

2011). Also, math skills have been found to be a strong predictor of later school performance (Claessens et al., 2009). As the effects of poor mathematical skills on later school achievement as well as future employment is evident, it is important to gain more knowledge on the connections between mathematical difficulties and upper secondary school dropouts.

1.4 Learning difficulties and dropping out of upper secondary education

Learning difficulties are seen as one of the strongest risk factors for dropping out of education (Kortering & Christenson, 2009; Deshler et al. 2001; Nurmi, 2011; Thurlow et al., 2012). Studies have shown that young students with poor reading skills are more likely to drop out of school than students with typical reading skills (Daniel et al., 2006). Also, reading difficulty diagnosed in childhood is a risk for dropping out of upper secondary school and employment in a low status occupation (Smart et al., 2017). Moreover, in a meta-analytic review strong effects were found for the risk factors for dropping out from low academic achievement and experiencing learning difficulties (Gubbels et al., 2019).

A few Finnish studies have also investigated the connection between learning difficulties and educational dropouts. In a five-year longitudinal study 16-year-olds´ school path was followed in Finland. The results showed that the academic learning difficulties measured in the 9th grade predicted the state of studies in the future (Hakkarainen et al., 2015). This indicate that the students who had learning difficulties in the 9th grade, were more likely to drop out of upper secondary education. Learning difficulties, especially in mathematics, were identified as the strongest predictor for dropping out in upper secondary education. Similar result was found in another study published by same researchers; difficulties in mathematics predicted lower levels of education more often than difficulties in reading (Hakkarainen et al., 2016).

Furthermore, difficulties in reading and mathematics were found as predictors for school achievement and the measured difficulties explained transition to upper secondary education (Hakkarainen et al., 2013). Also, the comorbidity of

learning difficulties increased the risk for dropout, as students with difficulties in both reading and mathematics were more likely to drop out of upper secondary education (Korhonen et al., 2013). Genetic factors may explain why many children with mathematical difficulty also have reading disability or other difficulty such as ADHD (Geary, 2011).

The connection between learning difficulties and upper education dropouts is evident, yet there is not enough evidence whether dropping out of education is connected to the type of learning difficulty (reading, mathematics etc.) or the severity of a disability (Korhonen et al., 2013). Also, the connection between reading skills and upper secondary education dropouts have been established in previous research, but there is not much knowledge about which type of reading skills (e.g., fluency, reading comprehension, technical reading skills) predict educational dropouts. This study aims to investigate the distinction between different subtypes of learning difficulties (mathematical and reading difficulties) and furthermore, between technical reading skills and reading comprehension skills in predicting dropping out of upper secondary education. Moreover, as the evidence of learning difficulties and school dropouts investigated through longitudinal studies is still fairly minor, this study aims to provide knowledge of the predicting effects of learning difficulties through using longitudinal data.

1.5 Socioeconomic background and dropping out of upper secondary education

Several previous studies indicate that the educational exclusion and dropping out of upper secondary school are associated with the student's low socio-economic background (see e.g., Gubbels et al., 2019; Hakkarainen et al., 2015; Vanttaja, 2015). Socioeconomic status is usually measured by parents´ education level, occupational status, or income (Cirino et al., 2012).

In the study conducted by Myhr et al. (2017), the completion rates in upper secondary education were significantly higher within families with parents´ high education level. Furthermore, the same study concluded that disadvantaged family structural conditions, such as large family size, young maternal age and

family disruption reduce the likelihood of completing upper secondary education. These conditions are common in families with low socio-economic status.

Also, according to Elffers (2011), students with low-educated parents report less parental support as well as less emotional and academic engagement. Parents´ ability to support their children with their studies apparently affects how well the students are engaging in school activities and aim to continue to educate themselves. The effects can be seen in Finland as studies indicate that the higher educated the parents are, the more likely the students are to educate themselves after compulsory education (Vanttaja, 2005) and parents´ socioeconomic status explain the state of studies in young adults´ life (Hakkarainen et al. 2015). Furthermore, parents´ low socioeconomic status correlates negatively to both boys´ and girls´ completion of upper secondary education (Eskelinen et al. 2020).

1.6 Research problem

In the present study, the aim is to investigate to what extent learning difficulties (difficulties in reading and mathematical learning difficulties) measured in the 9th grade predict dropping out of upper secondary education. Furthermore, the object of this study is to investigate the effects of socioeconomic background as a predictor for dropping out of upper secondary education for those students who have difficulties with learning.

To address the presented problem statement, this research sought to answer the following questions:

1. To what extent do academic learning difficulties measured in 9th grade (mathematical learning difficulties, difficulties in reading) predict dropping out of upper secondary education?

    b. Which kind of learning difficulty (difficulties in reading (technical reading skills or reading comprehension) or mathematical learning

difficulty) is a stronger risk factor for dropping out in upper secondary education?

2. To what extent the connection between learning difficulties measured in 9th grade and dropping out of secondary education is moderated by family´s socioeconomic background? In other words, what are the respective effects of socioeconomic background on this prediction?

Previous studies have established that learning difficulties increase the risk of dropping out (Deshler et al. 2001; Dunn et al., 2004; Hakkarainen et al., 2015; Kortering & Christenson, 2009; Nurmi, 2011;), and therefore it is expected in this study that measured learning difficulties in mathematics and reading in 9th grade would predict dropping out of upper secondary education (Hypothesis 1). There is evidence that difficulties in mathematics would be a stronger predictor for dropping out (Hakkarainen et al., 2015) and therefore we expect to find similar findings in this study (Hypothesis 2). Furthermore, family´s socioeconomic background has been found to be a predictor for dropping out of upper secondary education as student´s from low socioeconomic backgrounds more often drop out of upper secondary education (see e.g., Eskelinen et al., 2020; Myhr et al., 2017; Vanttaja, 2005). In this study we hypothesize that family´s low socioeconomic background would increase the risk of dropping out, as it can be expected that parents with higher educational level may have more knowledge and resources to support their child´s educational needs (Hypothesis 3).

2 RESEARCH METHODS

2.1 Research Data

The data used in the present study were drawn from the First Steps follow-up study (Lerkkanen et al. 2006–2016) and its extension, the School Path: From First Steps to Secondary and Higher Education study (Vasalampi and Aunola 2016–2020). In The First Steps follow-up study, approximately 2000 students were followed from early childhood education to the end of lower secondary school between the years 2006 and 2016. In the School Path: From First Steps to Secondary and Higher Education study, the participants were followed up twice during upper secondary education in the first year if their studies in upper secondary education in the spring 2017 and autumn 2018, when they were in their third year of studies. The data used in this study was collected when the students were in the ninth grade of lower secondary education in 2016. Students´ mathematical skills and reading skills were tested. Finally, in 2019 the information about graduation of upper secondary education was collected from the school registers.

Students from four different municipalities participated in the study (n= 4525). This research consists of participants (n=1476) that were in the ninth grade in the year 2016. Of them 1098 (74.39%) graduated from upper secondary education and 378 (25.60%) did not graduate by the year 2019. There were 713 (48.3%) boys and 763 (51.7%) girls in the data. Participants who did not declare their gender as boy or a girl were removed from the data (n=16).

2.2 Measurements

Graduating from upper secondary education within normative three years. Information on the state of studies was collected from the school registers, whether a student has completed upper secondary education within the year 2019 (coded as 0 = did not drop out, 1 = did drop out). There were 1476 participants in the

study, 1098 (74.39%) of them graduated from upper secondary education and 378 (25.60%) did not graduate by the year 2019.

Defining *learning difficulties* -groups. Students´ (*n* = 1476) skills in reading were tested with two tests, technical reading task and reading comprehension task and mathematical skills with arithmetic task in the ninth grade in the spring 2016. These tests were used to determine *reading difficulties* and *mathematical learning difficulties*. In research, learning difficulty is usually defined according to a cut-point (e.g., scoring in reading below the 10th percentile), and student who score below, is grouped into the "learning difficulty group" (see Fletcher, 2006; Geary et al. 2008). In this research, the learning difficulty was defined if the student scored in the lowest 10th percentage. Due to ties in the data, obtaining exactly 10% cut-point was not possible. Ties occur when multiple children have the same score on the test, making it not possible to determine a precise cut-off point for the 10th percentile. Therefore, the decision was made to create cut-points according to the closest possible percentage to 10th percentile. Learning difficulties variables were dichotomous, as having a difficulty was coded as 1, and not belonging to the lowest 10% was coded as 0. The exact cut-points for the three measurements were: for technical reading skills 11.1%, reading comprehension skills 7.8% and arithmetic skills 13.3%. Descriptive statistics of *learning difficulties group* -variables are shown in Table 1.

Reading difficulties. To measure *reading difficulties,* two test were conducted to test students´ *technical reading skills* and *reading comprehension skills*. These variables are treated as individual skills, as according to previous research literature these skills are separate from each other, nevertheless, can occur together (see Aro et al., 2008). The details of the test were as follows:

Technical reading. Technical reading task (ALLU- Reading Test for Primary School (Lindeman, 2000)) consists of 80 pictures of common items and four orthographically and phonologically similar words (e.g., pupu (bunny), pipo (cap), papu (bean), apu (help)). Two minutes time limit was set for students to match the picture to the correct word. A student gets scores for each correctly matched word and picture (max. 80).

Reading comprehension. In the reading comprehension test (Niilo Mäki Institute) students were given around 30 minutes to read the text and answer questions related to the text. The test consisted of 11 multiple choice questions, and 1 question where the student needed to arrange sentences in the order they were mentioned in the text. The types of questions vary, with some multiple-choice questions requiring a verbatim answer and others requiring interpretation and inference. A student gets 1 point for each correct answer (max. 12).

Mathematical learning difficulties. Students' arithmetic skills were measured with a numeracy test (Räsänen & Aunola), that consisted of 28 counting tasks. Time limit was 3 minutes. A student gets 1 point for each correct answer (max. 28).

Socioeconomic background. Parent´s level of education was used as an indicator for socioeconomic background. The children's parents (n=1220) indicated their educational levels on a seven-point scale from one (no vocational education) to seven (licentiate or doctoral degree). For this study, four categories were created. The recoded categories were as follows: 1 = comprehensive school only or comprehensive school and some vocational courses (n=42, 3.4 %); 2 = vocational school or high school degree (n=273, 22.4%); 3 = vocational college degree, polytechnic degree, or lower university degree (bachelor's) (n=440, 36.1%); 4 = higher university degree (i.e., master's, licentiate, or doctoral) (n=465, 38.1%).

Table 1. *Descriptive statistics of technical reading skills-, reading comprehension-and arithmetic skills -group variables*.

	Learning difficulty -group			No learning difficulties -group		
	n	*M*	*SD*	*n*	*M*	*SD*
Technical reading skills	187	25.99	4.42	1499	43.42	7.47
Reading comprehension	130	2.52	.71	1554	7.40	2.11
Arithmetic skills	255	8.44	1.88	1463	15.87	3.93

Note. M = Mean, = Standard deviation.

2.3 Data Analysis

Research question 1. To answer the first research question, *having difficulties* was defined as in belonging to the lowest performing group of the 9th grade test scores in technical reading, reading comprehension and arithmetic skills. The knowledge of whether the student has graduated upper secondary education is a dichotomous variable (0= graduated, 1= did not graduate). Before conducting the analysis, an intercept-only model was conducted. The purpose of running an intercept only model is to determine whether there is evidence of substantial clustering. If the evidence suggests that there is, multilevel modelling is needed (Osborne, 2015). The intercept-only model indicated that there was no evidence of clustering (Intraclass correlation = .02), so the data could be analysed through single level regression model. As the outcome variable is categorical, the analysis was carried out by using binary logistic regression model. The analysis was done by adding learning difficulties group -variables (technical reading skills and reading comprehensions skills, arithmetic skills) to the model without other variables.

To further analyse the connection between the learning difficulty group -variables and graduating upper secondary education, *Z*-test was carried out to examine the equality of coefficients. The used model and the interpretation procedure of the logistic regression analysis and testing the equality of regression coefficients is explained in more detail in the next section.

Research question 2. To answer the second research question the analysis was carried out in three steps: In Step 1 gender and family's socioeconomic background were added to the model without other predicting variables. In step 2 the *learning difficulties group* -variables were included to the analysis. In the last step, the interaction terms were added. An interaction term is created by multiplying the variables that are believed to have a joint effect on the outcome variable ($X_1 * X_2$). Interaction terms were formed of all the *learning difficulties group* -variables and socioeconomic background -variable (technical reading skills*socioeconomic background, reading comprehensions skills*socioeconomic background,

arithmetic skills* socioeconomic background). The effect of gender was controlled in the model (1=girl and 2=boy).

2.3.1 Logistic regression analysis

Many educational research problems are predicting outcome that either happens or not (whether student will pass the course or graduate from education, whether student has learning disability or not etc.), which is called a dichotomous outcome. To analyze and predict dichotomous outcomes, logistic regression analysis is used. Logistic regression is used for testing hypothesis about relationships between dichotomous outcome variable and one or more predictor variables (Peng, Lee & Ingersoll, 2002).

The formula to logistic regression with multiple predictors (as in this study, X_1 = technical reading score, X_2 = reading comprehension score and X_3= arithmetic test score), is constructed as follows:

$$logit(Y) = log(\frac{p}{1-p}) = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k.$$

There,

X_k= predictors

p = probability (outcome of interest)

β_0 = intercept

As predictors in this model are categorical, intercept represents the mean value of the outcome variable when all categorical predictors are at their reference levels (because 0=reference category). When X = 0, the intercept β_0 is the log of the odds of having the outcome.

β_k = regression coefficients

The hypotheses for this model are:

H_0: All β_k equal zero

H_1: at least one β_k does not equal zero in the population

If the dichotomous dependent variable is modeled using logistic regression, a linear relationship is assumed between the logit transformation of the dependent variable and predictor variables. The odds ratio (OR) measures how strongly an event is associated with exposure (Hoffman, 2017). Odd ratio greater than one indicates that the odds increase when the explanatory variable increases by one unit. Then again, odd ratios smaller than one indicate that an increase in the explanatory variable decreases the odd.

OR=1 Exposure does not affect odds of outcome
OR>1 Exposure related with higher odds of outcome
OR<1 Exposure related with lower odds of outcome

The odd ratios can have values between zero and infinity. However, regression analysis is most adequate for situations where the values of the variables can have unlimited values (varying between -∞ and +∞). Therefore, for logistic regression analysis, a natural logarithm is taken from the odds. The formula for log odds is:

$$logit(p) = log\frac{p}{(1-p)}$$

2.3.2 Testing the equality of two coefficients

To compare whether the effect of two different coefficients is equal in the model, further analysis is needed. The formula recommended for testing the equality of two coefficients in logistic regression by Paternoster et al. (1998) for the *Z*-test is as follows:

$$Z = \frac{B_1 - B_2}{\sqrt{(SE_{B_1})^2 + (SE_{B_2})^2}}$$

where B is the unstandardized (logit or logistic regression) coefficient and SE(B) is the standard error of that coefficient.

The hypotheses for this model are:

H_0: $B_1 = B_2$

H_1: $B_1 \neq B_2$

3 RESULTS

3.1 Descriptive statistics

The descriptive statistics and correlations between dropping out of upper secondary education and explanatory variables are presented in Table 2.

Table 2. *Correlations between dropping out of upper secondary education and explanatory variables, means, standard deviations (SD), skewness and kurtosis.*

	Scale	1.	2.	3.	4.	5.	6.
1.Dropping out (*n* = 4040)	0-1	1					
2. Technical reading (*n* = 1686)	0-1	-.05*	1				
3. Reading comprehension (*n* = 1684)	0-1	-.08***	.14***	1			
4. Arithmetic skills (*n* = 1688)	0-1	-.08**	.17***	.10***	1		
5. Socioeconomic background (SES) (*n* = 1738)	1-4	-.07**	.06*	.10***	.13***	1	
6. Gender (*n* = 4525)	1-2	.02	-.13***	-.07**	.07**	.05*	1
M		1.27	41.49	7.02	14.88	3.02	1.47
SD		0.447	9.04	2.42	3.93	0.87	.499
Skewness		1.008	-0.026	-0.120	-0.134	-0.404	0.132
Kurtosis		-0.984	0.259	-0.616	0.043	-0.819	-1.98

Note. ***p< 0.001, **p < 0.01, *p < 0.05; Dropping out; 0 = Did not drop out, 1 = Did drop out; Learning difficulties groups; 0 = No difficulties in technical reading, 1 = Difficulties in technical reading; 0 = No difficulties in reading comprehension, 1 = Difficulties in reading comprehension; 0 = No difficulties in arithmetic skills, 1 = Difficulties in arithmetic skills; Socioeconomic background, 1 = comprehensive school only or comprehensive school and some vocational courses, 2 = vocational school or high school degree, 3 = vocational college degree, polytechnic degree, or lower university degree (bachelor's); Gender 1=girl, 2=boy. *M* = Mean, *SD* = Standard deviation.

3.2 Learning difficulties predicting dropping out of upper secondary education

Logistic regression analysis was conducted to examine the relationship between student´s technical reading skills (predictor 1) and reading comprehensions skills (predictor 2), arithmetic skills (predictor 3), measured in 9th grade and the odds of not graduating from upper secondary education. The model aimed to predict whether the student graduated from upper secondary education based on these variables.

First the *learning difficulties group* -variables (technical reading skills, reading comprehensions skills and arithmetic skills) were added to the model without other variables. The model was statistically significant x^2= (3, n =1476) =19.197, p <.001, suggesting that it could distinguish between those graduating and not graduating upper secondary school. The model explained between 1.2% (Cox & Snell R square) and 1.8% (Nagelkerke R square) of the variance in the dependent variable. This implicates that there are many other factors that predict dropping out of upper secondary education, and that indicates that dropping out as a phenomenon is very complex. According to Hosmer & Lemeshow´s test the model was adjustable for this data: x^2(2) =.401, p = 818. This model classified in total of 74.5 % of cases correctly classifying 99.5 % of the students who did graduate correctly and 1.9% of the students who did not graduate correctly.

It was found that the odds of not graduating upper secondary education increased by 1.73 times (95% CI OR [1.13, 2.64]) if the student belonged to the lowest 10% of the reading comprehension skills. Furthermore, another finding was that if student belonged to the lowest 10% of the arithmetic skills, the odds of not graduating upper secondary education increased by 1.58 times (95% [1.12, 2.21] Technical reading skills did not have a significant effect on dropping out of secondary education, when all the three predictor variables were in model at the same time. The results of logistic regression analysis are shown in Table 3.

Table 3

Logistic Regression Predicting the Odds of Not Graduating Upper Secondary Education

	B	*SE*	Wald	*df*	*p*	*OR*	95%CI OR	
							LL	*UL*
Technical Reading	.24	.19	1.51	1	.22	1.27	.87	1.86
Reading comprehension	.55	.22	6.43	1	.01	1.73	1.13	2.64
Arithmetics	.45	.17	6.88	1	.01	1.58	1.12	2.21
Constant	-1.20	.07	301.861	1	.001	.30		

Note. B = logistic regression coefficient; *SE* = standard error; *OR* = odds ratios, *95%CI OR*= confidence interval for odds ratios, *LL*= lower level, *UL*=upper level. Learning difficulties groups; 0=No difficulties in technical reading (reference category), 1 = Difficulties in technical reading; 0=No difficulties in reading comprehension (reference category), 1 = Difficulties in reading comprehension; 0 = No difficulties in arithmetic skills (reference category), 1 = Difficulties in arithmetic skills.

To test the hypothesis that the reading comprehension test score (B =.55) and arithmetic test score (B =.45) coefficients were statistically significantly different from each other. The results showed that the regression coefficients did not statistically differentiate from each other (Z=.34, p=.734).

3.3 Learning difficulties and socioeconomic background as predictors of dropping out of upper secondary education

For the second research question family´s socioeconomic background and gender were added in the model. The aim was to investigate whether the connection between measured learning difficulties (difficulties in technical reading skills (predictor 1), difficulties in reading comprehensions skills (predictor 2), difficulties in arithmetic skills (predictor 3) and dropping out of education change, when the socioeconomic background and gender are in the model.

In Step 1 gender and family's socioeconomic background were added to the model without other predicting variables. According to Omnibus test of Model Coefficients, Step 1 model was not statistically significant x^2= (3, n =1220) =4.772, p =.311, indicating that gender and socioeconomic background statistically did not explain dropping out of upper secondary education. Hosmer and Lemeshow´s test indicated that model was adjustable for the data: x^2(4) =2.579, p = .631. This model classified in total of 75.7 % of cases correctly classifying 100 % of the students who did graduate correctly and 0% of the students who did not graduate correctly. There was no significant connection between gender and socioeconomic background and dropping out of upper secondary education.

In step 2 the predictor variables (difficulties in technical reading skills (predictor 1), difficulties in reading comprehensions skills (predictor 2), difficulties in arithmetic skills (predictor 3)) were added to the model. The model was statistically significant x^2= (7, n =1220) = 14.30, p <.046, suggesting that it could distinguish between those graduating and not graduating upper secondary school. The model explained between 1.2% (Cox & Snell R square) and 1.7% (Nagelkerke R square) of the variance in the dependent variables. According to Hosmer & Lemeshow´s test the Step 2 model was adjustable for this data: x^2(6) =8.106, p = .230. This model classified in total of 75.7 % of cases correctly classifying 100% of the students who did graduate correctly and 0% of the students who did not graduate correctly.

It was found that the odds of not graduating upper secondary education increased by 1.671 times (95% CI OR [1.129, 2.472]) if the student belonged to the lowest 10% of the arithmetic skills when family´s socioeconomic background and gender were controlled. Reading comprehension did not explain dropping out of education after controlling family´s socioeconomic background and gender. The results of logistic regression analysis are shown in Table 4.

In the last step (Step3), the socioeconomical background was added to the model as an interaction term to investigate the interaction between learning difficulties (technical reading skills, reading comprehension and arithmetic skills) and socioeconomical background. The model was marginally significant x^2= (16,

n =1220) = 24.91, p=.071. The model explained between 2.0% (Cox & Snell R square) and 3.0% (Nagelkerke R square) of the variance in the dependent variables. According to Hosmer & Lemeshow´s test the Step 3 model was adjustable for this data: $x^2(7)$ =7.462, p = .382. This model classified in total of 76.0 % of cases correctly classifying 99.2% of the students who did graduate correctly and 3.7% of the students who did not graduate correctly.

The results show that there was one significant interaction effect found on dropping out of upper secondary education (see Table 4).

Table 4

Logistic Regression Predicting the Odds of Not Graduating Upper Secondary Education

	B	*SE*	Wald	*df*	*p*	*OR*	95%CI OR	
Step 1.							*LL*	*UL*
Gender	-.10	.14	.53	1	.47	.91	.70	1.18
SES 1			3.96	3	.27			
SES 2	-.18	.36	.24	1	.62	.84	.41	1.70
SES 3	-.29	.35	.70	1	.41	.75	.38	1.49
SES 4	-.48	.35	1.82	1	.18	.62	.31	1.24
Constant	-.76	.34	5.05	1	.03	.47		
Step 2.								
Gender	-.13	.14	.91	1	.34	.88	.67	1.15
SES 1			1.82	3	.61			
SES 2	-.13	.36	.12	1	.73	.88	.43	1.80
SES 3	-.20	.36	.31	1	.58	.82	41	1.65
SES 4	.33	.27	.86	1	.35	.71	.36	1.45
Technical Reading	.13	.24	.30	1	.58	1.14	.71	1.84
Reading comprehension	.43	.27	2.48	1	.16	1.53	.90	2.61
Arithmetics	.51	.20	6.60	1	.01	1.67	1.13	2.47
Constant	-.94	.35	7.36	1	.01	.39		
Step 3.								
Gender	-.16	.14	1.28	1	.26	.86	.65	1.12
SES 1			1.94	3	.58			
SES 2	-.52	.45	1.30	1	.25	.60	.25	1.45
SES 3	-.39	.44	.80	1	.22	.59	.29	1.39
SES 4	-.53	.44	1.49	1	.22	.59	.25	1.38
Techical Reading	.93	.93	1.0	1	.32	2.52	.41	15.53
Reading comprehension	.05	1.37	.001	1	.97	1.05	.07	15.29

Table 3 Continued

	B	*SE*	Wald	*df*	*p*	*OR*	95%CI OR	
							LL	*UL*
Arithmetics	-.86	.88	.97	1	.32	.42	.08	2.35
Technical reading*SES 1			3.66	3	.30			
Technical reading*SES 2	-.45	1.01	.19	1	.66	.64	.09	4.67
Technical reading*SES 3	-.88	1.01	.76	1	.38	.41	.06	3.01
Technical reading*SES 4	-1.72	1.12	2.36	1	.13	.18	.02	1.61
Reading compr.*SES 1			.13	3	.99			
Reading compr.* SES 2	.46	1.44	.10	1	.74	1.60	.10	26.61
Reading compr.*SES 3	.37	1.44	.07	1	.80	1.44	.09	24.16
Reading compr.*SES 4	.29	1.49	.04	1	.84	1.34	.07	25.03
Arithmetics*SES 1			5.08	3	.17			
Arithmetics*SES 2	1.86	.94	3.86	1	.05	6.38	1.00	40.56
Arithmetics*SES 3	1.10	.94	1.39	1	.24	3.01	.48	18.83
Arithmetics*SES 4	1.51	.97	2.40	1	.12	4.51	.67	30.45
Constant	-.69	.42	3.68	1	.10	.50		

Note. B= logistic regression coefficient; *SE* = standard error; *OR* = odds ratios, *95%CI OR*= confidence interval for odds ratios, *LL*= lower level, *UL*=upper level, Learning difficulties groups; 0=No difficulties in technical reading (reference category), 1 = Difficulties in technical reading; 0=No difficulties in reading comprehension (reference category), 1 = Difficulties in reading comprehension; 0 = No difficulties in arithmetic skills (reference category), 1 = Difficulties in arithmetic skills; SES 2 = comprehensive school, vocational courses, SES 3 = vocational college degree, polytechnic degree, or lower university degree (bachelor's), SES 4 = higher university degree (i.e., master's, licentiate, or doctoral), SES 1 as a reference category ("comprehensive school, vocational courses "). "Girl=1" as a reference category.

4 DISCUSSION

The purpose of this study was to investigate to what extent learning difficulties measured in the 9th grade predict dropping out of upper secondary education. Furthermore, this study aimed to find out to whether the connection between learning difficulties and dropping out of secondary education is moderated by family´s socioeconomic background.

This longitudinal study showed that learning difficulties predict dropping out of upper secondary education. Difficulties in arithmetic skills and reading comprehension explained dropping out of upper secondary education, when only *learning difficulties group* -variables were in the model. This result support the findings from previous research literature, as learning difficulties have been found to be one of the strongest risk factors for educational dropouts (Deshler et al. 2001; Kortering & Christenson, 2009; Nurmi, 2011; Thurlow, Sinclair & Johnson, 2012). The test of the equality of the coefficients of reading comprehension skills and arithmetic skills indicated that there is no significant difference between the coefficients, so either of the measured skills is stronger predictor than other when the analysis included only *learning difficulties group* -variables as predictors.

Furthermore, results in this study showed that reading comprehension did predict dropping out of upper secondary education, but technical reading did not have effect on dropping out. This finding supported the hypothesis partially as only reading comprehension predicted dropping out of upper secondary education. One possible explanation for this result could be that the students whose technical reading skills were low, still perform well in reading comprehension. This is also in line with the previous knowledge that technical reading skills and reading comprehension skills can occur separate from each other (Aro et al. 2008).

This finding also suggests that student´s technical reading skills might not play such an important role in upper secondary education as the studies require more complex strategies that allow students to read and process information from texts. These strategies are considered as higher cognitive processes that

enable the reader to create meaningful representations of the text and words being read (Jakobson et al., 2022). Therefore, in special education, focus on practising technical reading skills such as decoding or reading fluency, might not be expedient with secondary school-aged students, but rather the focus should better be in improving reading comprehension skills such as reading strategies, inference making skills and also, reading motivation. Adequate reading comprehension plays an important role in student´s school path, as reading comprehension skills have been found to be in connection to school performance in previous studies (Panula, 2013), as well as according to this study, to upper secondary school dropouts.

Arithmetic skills were also found to be a predictor for educational dropout in upper secondary education. A rather interesting finding is that after investigating the connections between family´s socioeconomic background and learning difficulties, student´s arithmetic skills still explained dropping out of upper secondary education, but reading comprehension did not have effect in dropping out after that. This is an important finding as this result indicates that student´s arithmetic skills seem to be a stronger predictor for educational dropout than reading comprehension skills. The connection between mathematical difficulties and educational dropouts have been established only in few longitudinal studies in Finland, (Hakkarainen et al., 2015; Hakkarainen et al., 2012; Korhonen et al., 2013), and results from this study provide valuable support for these previous findings. As well, this study offers knowledge of the connection between student´s arithmetic skills and educational dropouts in upper secondary school. Furthermore, there is not much knowledge of the connection between different subtypes of learning difficulties and educational dropouts, as only few Finnish longitudinal studies have investigated the connections between mathematical difficulties and reading difficulties in the same study (see Hakkarainen et al., 2016; Hakkarainen et al. 2015; Korhonen et al., 2013), which would allow the comparison of different types of learning difficulties.

Student´s socioeconomic background or gender did not statistically predict dropping out of upper secondary education in this study when they were added

in the model without other predictors. This result indicates that there are other predictors that explain dropping out of upper secondary education within the participants in this study. Thus, the effect of socioeconomic background was mediated through learning difficulties in this study; when the socioeconomic background was in the model with other predicting variables, reading comprehension did not predict dropping out of education. This indicates, that the higher the socioeconomic background of the family is, the better are the reading comprehension skills, and the lower is the risk for dropping out of upper secondary education. In previous studies, the connection between reading comprehension and socioeconomic status has been found, as students with lower socioeconomic background tend to perform worse in reading comprehension skills (See e.g., Van der Kleij et al., 2022). The connection between arithmetic skills and dropping out of education remained significant after including socioeconomic background in the analysis. This result indicates that the effect of student´s arithmetic skills on dropping out of education is so strong, that even the family´s situation will not affect the outcome.

Also, one interaction effect was found. This finding suggests that if the student´s arithmetic skills were poor and the highest level of education of either of the parent was "vocational school or high school", the more likely the student dropped out of upper secondary education compared to the situation where either of student´s parent´s level of education was "comprehensive school or some vocational courses". This result is rather surprising, as in this case the risk of dropping out of upper secondary education increased when the parents had graduated from upper secondary education. One possible explanation could be that the lower the education of the parents is, the more there might be also other challenges besides mathematical learning difficulties, that require support. Therefore, the need for support can be detected more easily and the support could be more intense for the child with lowest socioeconomic background. This could decrease the risk for dropping out of upper secondary education. Students that have higher socioeconomic background possibly do not receive as much

support during their studies for mathematical learning difficulties, as there might not be other visible challenges that require support.

4.1 Limitations and future research

This study has some limitations that need to be considered when interpreting the results. Firstly, to measure mathematical learning difficulties, only arithmetic skills were used as a measure. This study does not provide knowledge of the connections between other mathematical sub-skills or specific diagnosed mathematical learning disability and dropping out of education. Furthermore, previous research has established tight relationship between mathematical difficulties and reading difficulties (see e.g., Andersson, 2010; Dirks et al., 2008) as there are students that have difficulties in both reading and mathematics. Also, many students that have learning difficulties in mathematics or reading, also have challenges with behaviour and/or attention (Auerbach et al. 2008; Hakkarainen et al., 2016). In the future research it would be interesting to investigate, whether students with comorbidity difficulties are at higher risk for dropping out compared to ones with only difficulties in either of skills, or what kind of profiles are at the highest risk of dropping out.

Secondly, this study was conducted in Finnish school system, and therefore the interpretation of the results should be done with caution when comparing them to other education systems. Thirdly, the information of the graduation from the upper secondary education was collected from the school registers only at one timepoint. Not graduating within certain period of time, does not automatically mean that the student will stay without upper secondary education for the rest of their lives.

Fourthly, there are some limitations regarding the analysis method, that should be taken into consideration. At its best, the model was able to classify all of the graduated students correctly but managed to classify only 3.7 % of the non-graduated students correctly. At some steps, none of the non-graduating students were ranked correctly, which may be due to the fact that the probability of

0.5 has been set as the limit for classification, and this is apparently not enough as a limit for correct classification (Metsämuuronen, 2008). The problem may also be that the variables are clustered/nested or subordinate to each other, i.e. they are not equal in terms of explanation, as our model assumes. However, the clustering of the data was tested before conducting the analysis, and the results indicated that the data is not nested, and therefore logistic regression was used as an analysis method. The model could have been re-evaluated, for example by changing the classification limit, or by trying different cut-off values, because now the model does not fully model dropping out of upper secondary school. Nonetheless, dropping out of education is a complex phenomenon, and building a model that is able to explain educational dropouts is rather challenging. This study aimed to investigate learning difficulties as predictors for dropout, and the connection between the predictors and dropping out of education was found. Yet, there are still gaps that this study did not investigate, which leaves room for future research.

As previous studies have indicated, students with learning difficulties require additional support during their studies (Tunmer & Greaney, 2010). The sooner the support is arranged for the student, the easier it is to prevent an accumulation of challenges in the future (Ministry of Education and Culture, 2023). Furthermore, students that receive special education are at higher risk of dropping out of upper secondary education, and students who have accomplished primary and secondary school according to individual study plan, academically perform the worst (Ristikari et al., 2018). According to the results of this study, students with mathematical difficulties have the highest risk of dropping out of education. Therefore, investigating the connection between the effects of received support on learning difficulties, especially on mathematical learning difficulties, and educational dropouts is important as only few longitudinal studies have investigated the role of educational support on dropping out of upper secondary education (see e.g., Hakkarainen et al. 2015). Furthermore, some students receive more intensive support for their learning difficulties through rehabilitation, which is usually offered outside school (i.e., neuropsychological rehabilitation).

There is no previous research available on the effects of rehabilitation on dropping out of education. Investigating the role of educational -and other support for learning difficulties would offer knowledge of the efficiency and functionality of the existing support system on preventing educational dropouts.

4.2 Ethical consideration and practical implications

The data used in this study, School path: From initial stages to further studies, is funded by the Academy of Finland and it was approved by the Jyväskylä Ethics Committee in 2018. As I have not collected the data used in this study by myself, I was not able to influence the ethical decisions related to the data collection process. However, I am obligated to follow the guidelines of good scientific practice (GSP). These guidelines include the core values of integrity and transparency when conducting research and evaluating and presenting the results (TENK, 2023). Furthermore, while conducting the research, the data should be handled in such a way that the identity of the participants remains secure. Also, I must make sure that the data is stored in a well-secured place. After the research is completed, the data will be destroyed.

According to this study, difficulties in arithmetic skills was the strongest predictor of dropping out of upper secondary education, and the connection remained statistically significant even when family´s socioeconomic background was controlled. This gives valuable information for education professionals when planning adequate interventions and support for students with learning difficulties. According to the results of this study, it could be that higher educated parents can support their children with contents that require reading comprehension skills, but mathematical difficulties possibly require more intensive and targeted support, that should be offered through special education and/or rehabilitation services.

As the compulsory school age is extended to eighteen in Finland, the need for adequate and efficient support for learning difficulties in upper secondary education is evident. The number of students with need of additional support for

learning is only rising (Statistics Finland, 2021b), and this poses a challenge for education institutes to meet the demands. More information about the predictors of dropping out of education is needed. Also, the reform of the social welfare system (SOTE) was put into practice in the beginning of the year 2021 in Finland, and at the school level it affects the work and availability of schools´ welfare professionals. The school psychologists will no longer work at schools, which is a huge issue as working remotely can jeopardize cooperation between the school welfare group actors (The Finnish Psychological Association, 2021). This might have a negative impact on the students' right to access psychological examinations and may further delay the already long diagnostic process for identifying learning disabilities. Therefore, research about connection between learning difficulties and school dropouts is crucial, as the education system as well as social welfare system should be improved towards actual needs of the students.

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. https://doi.org/10.1037/a0016838

Aro, T., Eklund K, Eloranta, A-K., Närhi, V., Korhonen, E., Ahonen, T. (2019). Associations between childhood learning disabilities and adult age mental health problems, lack of education, and unemployment. *Journal of Learning Disabilities;* 52 (1): 71–83. https://doi.org/10.1177/0022219418775118

Aro, T., Lehto, J. E. & Peltonen, M. 2008. Luetun ymmärtäminen vaikeaa? [Reading comprehension difficult?] In L. Kairaluoma, T. Ahonen, M. Aro, I. Kakkuri, K. Laakso, M. Peltonen & K. Wennström (Eds.). Lukemalla ja tekemällä. Opettajan opas lukivaikeudesta ammatillisille oppilaitoksille. [By reading and doing. A teacher's guide to reading disability for vocational schools]. Jyväskylä: Kopijyvä, 58-77.

Auerbach, J. G., V. Gross-Tsur, O. Manor, and R. S. Shalev. 2008. Emotional and Behavioral Characteristics over a Six-year Period in Youths with Persistent and Nonpersistent Dyscalculia. *Journal of Learning Disabilities,* 41 (3): 263–273. 10.1177/0022219408315637. https://doi.org/10.1177/0022219408315637

Aunola, K., Leskinen, E., Lerkkanen, M.-K., & Nurmi, J.-E. (2004). Developmental dynamics of math performance from preschool to Grade 2. *Journal of Educational Psychology*, 96, 699 –713. https://doi.org/10.1037/0022-0663.96.4.699

Böckerman, P. & Maczulskij, T., (2016). The Education-health Nexus: Fact and fiction. *Social science & medicine (1982),* 150, 112-116. https://doi.org/10.1016/j.socscimed.2015.12.036

Daniel, S. S., Walsh, A. K., Goldston, D. B., Arnold, E. M., & al, e. (2006). Suicidality, school dropout, and reading problems among adolescents.

Journal of Learning Disabilities, 39(6), 507-14. https://doi.org/10.1177/00222194060390060301

Dirks, E., Spyer, G., van Lieshoult, E. C. D.M., & de Sonneville, L. (2008). Prevalence of combined reading and arithmetic disabilities. *Journal of Learn-ing Disabilities,* 41(4), 460–473. https://doi.org/10.1177/0022219408321128

Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The prevention, identification, and cognitive determinants of math difficulty. *Journal of Educational Psychology*, 97(3), 493–513. https://doi.org/10.1037/0022-0663.97.3.493

Geary, D. C., Hoard, M. K., Nugent, L., & ByrdCraven, J. (2008). Development of number line representations in children with mathematical learning disability. *Developmental Neuropsychology*, 33, 277–299. https://doi.org/10.1080/87565640801982361

Gerber, P., J. (2012). The Impact of Learning Disabilities on Adulthood: A Review of the Evidenced-Based Literature for Research and Practice in Adult Education. *Journal of learning disabilities*, 45(1), 31-46. https://doi.org/10.1177/0022219411426858

Gubbels, J., van der Put, C., & Assink, M. (2019). Risk Factors for School Absenteeism and Dropout: A Meta-Analytic Review. *Journal of youth and adolescence*, 48(9), 1637-1667. https://doi.org/10.1007/s10964-019-01072-5

Eloranta, A.-K. (2019). A follow-up study of childhood learning disabilities – Pathways to adult-age education, employment, and psychosocial wellbeing. JYU Dissertations 155. Jyväskylä: University of Jyväskylä.

Elffers, L. (2011). One foot out the school door? Interpreting the risk for dropout upon the transition to post-secondary vocational education. *British Journal of Sociology of Education,* 33(1), 41-61. https://doi.org/10.1080/01425692.2012.632866

Eskelinen, N., Hautala, H., Lintunen, L. & Kallio, J. (2020). Ylisukupolviselle huono-osaisuudelle altistavat ja siltä suojaavat ei-materiaaliset tekijät. [Non-material factors that expose and protect against intergenerational

poverty].Tutkimuskatsauksia, Turun Kaupunki. Kaupunkitutkimusohjelma. [Research reviews, City of Turku. Urban Research Programme]. https://www.turku.fi/sites/default/files/atoms/files/tutkimuskatsauksia_3-2020.pdf

Estevao, P., & Alvares, M. (2014). What do we mean by school dropout? Early School Leaving and the shifting of paradigms in school dropout measurement. *Portuguese journal of social science*, 13(1), 21-32. https://doi.org/10.1386/pjss.13.1.21_1

European Commission. (2022, 31 October). *Glossary:Early leaver from education and training*. Eurostat Statistics Explained. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Early_leaver_from_education_and_training

European Commission. (2023, 15 June). *Early leavers from education and training*. Eurostat Statistics Explained. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Early_leavers_from_education_and_training

Hakkarainen, A. M., Holopainen, L. K., & Savolainen, H. K. (2013) Mathematical and Reading Difficulties as Predictors of School Achievement and Transition to Secondary Education, *Scandinavian Journal of Educational Research*, 57(5), 488-506. https://doi.org/10.1080/00313831.2012.696207

Hakkarainen, A. M., Holopainen, L. K., & Savolainen, H. K. (2015). A Five-Year Follow-Up on the Role of Educational Support in Preventing Dropout From Upper Secondary Education in Finland. *Journal of Learning Disabilities*, 48(4), 408-421. https://doi.org/10.1177/0022219413507603

Hakkarainen, A. M., Holopainen, L. K., & Savolainen, H. K. (2016). The impact of learning difficulties and socioemotional and behavioural problems on transition to postsecondary education or work life in Finland: A five-year follow-up study. *European journal of special needs education*, 31(2), 171-186. https://doi.org/10.1080/08856257.2015.1125688

Halpern-Manners, A., Schnabel, L., Hernandez, E.M., Silberg, J.L. & Eaves, L.J. (2016). The Relationship between Education and Mental Health: New Evidence from a Discordant Twin Study. *Social Forces*, 95(1), 107–131. https://doi.org/10.1093/sf/sow035

Hjalmarsson, R., Holmlund, H., & Lindquist, M. J. (2015). The effect of education on criminal convictions and incarceration: Causal evidence from micro-data. *The Economic journal (London),* 125(587), 1290-1326. https://doi.org/10.1111/ecoj.12204

Huttunen, K. & Pekkarinen, T. (2016). Koulutuksen nivelvaiheet ja nuorten syrjäytyminen. [Educational transitions and the exclusion of young people]. Nuorisotutkimusseura ry. https://www.nuorisotutkimusseura.fi/images/tiedostot/nakokulma21nuoruus_hallitusohjelmassa.pdf

Huttunen, K., Pekkarinen, T., Uusitalo, R. & Virtanen, H. (2023). Lost boys? Secondary education and crime. *Journal of Public Economics*, 218, 104804. https://doi.org/10.1016/j.jpubeco.2022.104804.

Kendeou, P., Van Den Broek, P., Helder, A., & Karlsson, J. (2014). A cognitive view of reading comprehension: Implications for reading difficulties. *Learning Disabilities Research and Practice*, 29(1), 10–16. https://doi.org/10.1111/ldrp.12025

Kleij, S. W., Burgess, A. P., Ricketts, J., & Shapiro, L. R. (2023). Tracking vocabulary and reading growth in children from lower and higher socioeconomic backgrounds during the transition from primary to secondary education. Child development, 94(1), e57-e66. https://doi.org/10.1111/cdev.13862

Kortering, L.J., & Christenson, S. (2009). Engaging Students in School and Learning: The Real Deal for School Completion. *Exceptionality : the official journal of the Division for Research of the Council for Exceptional Children,* 17(1), 5-15. https://doi.org/10.1080/09362830802590102

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. https://doi.org/10.1080/08856250110074391

Jordan, N. C., Kaplan, D., & Hanich, L. B. (2002). Achievement growth in children with learning difficulties in mathematics: Findings of a two-year longitudinal study. *Journal of Educational Psychology*, 94(3), 586–597. https://doi.org/10.1037/0022-0663.94.3.586

Järvinen, T. & Vanttaja, M. (2013). Koulupudokkaiden työurat – vuosina 1985 ja 1995 koulutuksen ja työn ulkopuolella olleiden nuorten urapolkujen vertailua [Career paths of young people out of education - comparing the career paths of young people out of education and employment in 1985 and 1995.] Yhteiskuntapolitiikka 78, 5, 509–519. https://www.julkari.fi/bitstream/handle/10024/110584/jarvinen.pdf?sequence=2

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. 29–47). Baltimore, MD: Brookes.

Mazzocco, M. M. M., & Thompson, R. E. (2005). Kindergarten predictors of math learning disability. *Learning Disabilities Research & Practice*, 20, 142–155. https://doi.org/10.1111/j.1540-5826.2005.00129.x

Metsämuuronen, J. (2008). *Muuttujamenetelmien perusteet. Metodologia-sarja 7.* [Basics of multivariate methods. Methodology-serie 7]. (2nd edition). Gummerus kirjapaino Oy, Jyväskylä.

Ministry of Education and Culture (2023, July). *Finnish Education System*. https://okm.fi/en/education-system

Myhr, A., Lillefjell, M., Espnes, G. A., & Halvorsen, T. (2017). Do family and neighbourhood matter in secondary school completion? A multilevel study of determinants and their interactions in a life-course perspective. *PLoS One*, 12(2). https://doi.org/10.1371/journal.pone.0172281

Määttä, S., Pelkonen, J., Lehtisare, S., & Määttä, M. (2020). Kouluakäymättömyys Suomessa: Vaativan erityisen tuen VIP-verkoston

tilannekartoitus [Truancy in Finland: A situation survey of the VIP network for intensive special education support.] Finland Ministery of Education. https://www.oph.fi/sites/default/files/documents/kouluakaymattomyys_suomessa_0.pdf

Niilo Mäki Institute. (2023). Matematiikka [Mathematics]. https://www.nmi.fi/niilo-maki-instituutti/tietoa-oppimisesta-ja-oppimisvaikeuksista/matematiikka/

Nurmi, J. (2011). Miksi nuori syrjäytyy? [Why do young people become excluded?] NMI-bulletin: Niilo Mäki institute newsletters and reports, 21(2), 28-35. https://bulletin.nmi.fi/2011/04/12/miksi-nuori-syrjaytyy/

OECD. (2020). *Education Policy Outlook*. https://www.oecd.org/education/policy-outlook/country-profile-Finland-2020.pdf

Osborne, J. (2015). Multilevel modeling with logistic regression. (Vols. 1-0). *SAGE Publications*. https://doi.org/10.4135/9781483399041

Panula, A. M., (2013). Lukemisvaikeudet ja osa-aikainen erityisopetus. Seurantatutkimus esikoulusta yhdeksännen luokan loppuun. [Reading difficulties and part-time special education. Follow-up study from pre-school to ninth grade.] [Doctoral dissertation, University of Helsinki]. https://helda.helsinki.fi/bitstream/handle/10138/38160/lukemisv.pdf?sequence=1&isAllowed=y

Paternoster, R., Brame, R., Mazerolle, P., & Piquero, A. (1998). Using the correct statistical test fot the equality of regression coefficients. *Criminology (Beverly Hills)*, 36(4), 859-866. https://doi.org/10.1111/j.1745-9125.1998.tb01268.x

Patrick, M. E., Schulenberg, J. E., & O'Malley, P. M. (2016). High School Substance Use as a Predictor of College Attendance, Completion, and Dropout: A National Multicohort Longitudinal Study. *Youth & Society,* 48(3), 425–447. https://doiorg.ezproxy.jyu.fi/10.1177/0044118X13508961

Peng, C. J., Lee, K. L., & Ingersoll, G. M. (2002). An Introduction to Logistic Regression Analysis and Reporting. *The Journal of educational research (Washington, D.C.)*. 96(1), 3-14. https://doi.org/10.1080/00220670209598786

Salihu, L., & Räsänen, P. (2018). Mathematics Skills of Kosovar Primary School Children: A Special View on Children with Mathematical Learning Difficulties. *International Electronic Journal of Elementary Education,* 10(4), 421-430. https://doi.org/10.26822/iejee.2018438132

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(2), 201-210. https://doi.org/10.1016/j.learninstruc.2007.09.017

Siiskonen, T. (2010). Kielelliset erityisvaikeudet ja lukemaan oppiminen. [Specific linguistic difficulties and learning to read]. [Doctoral dissertation, University of Jyväskylä]. https://jyx.jyu.fi/bitstream/handle/123456789/23093/9789513938413.pdf?sequence=1&isAllowed=y

Smart, D., Youssef, G.J., Sanson, A., Prior, M., Toumbourou, J.W. and Olsson, C.A. (2017). Consequences of childhood reading difficulties and behaviour problems for educational achievement and employment in early adulthood. *British journal of educational psychology,* 87(2), 288-308. https://doi.org/10.1111/bjep.12150

Statistics Finland. (2021a). *Educational structure of population.* https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__vkour/

Statistics Finland. (2021b). *Oppimisen tuki [verkkojulkaisu].* [Support for learning [online publication]]. [Cited 22.2.2023]. ISSN=2954-0658. https://www.stat.fi/julkaisu/cktyiw7xc2e8w0c586gqxm122

Statistics Finland. (2022, 17 March). *Keskeyttäminen lisääntyi toisella asteella etenkin ammatillisessa koulutuksessa ja väheni korkea-asteella 2020.* [Dropping out of education increased in secondary education, especially in vocational

education, and decreased in higher education in 2020]. https://tilastokeskus.fi/til/kkesk/2020/kkesk_2020_2022-03-17_tie_001_fi.html

Statistics Finland. (2023). *Koulupudokas.* [Early school leaver]. https://www.stat.fi/meta/kas/koulupudokas.html

Strømsø, H. I., Bråten, I., & Samuelstuen, M. S. (2003). Students' strategic use of multiple sources during expository text reading: A longitudinal think-aloud study. *Cognition and Instruction*, 21(2), 113–147. https://doi.org/10.1207/S1532690XCI2102_01

Suonpää, K., Pentikäinen, E., Ohtonen, M., Hokkanen, L., Sarkia, K., Hiilamo, H., Kivivuori, J., & Latvala, A. (2023). Syrjäytymisen ja huono-osaisuuden yhteys turvallisuuteen: kausaliteetista politiikkatoimiin. (Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 2023:29). [The connection of exclusion and disadvantage to security: from causality to policy action. (Government investigation and research publication series 2023:29)]. Valtioneuvoston kanslia. http://urn.fi/URN:ISBN:978-952-383-428-6

Swanson, H. L., & Beebe-Frankenberger, M. (2004). The relationship between working memory and math ematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology,* 96(3), 471–491. https://doi.org/10.1037/0022-0663.96.3.471

Finnish National Board on Research Integrity Tenk. (2023). *Responsible Conduct of Research (RCR*). https://tenk.fi/en/research-misconduct/responsible-conduct-research-rcr

The Finnish Psychological Association. (2021). Suomen Psykologiliiton lausunto sosiaali- ja terveysvaliokunnalle. [Statement by the Finnish Psychological Association to the Committee on Social Affairs and Health]. https://www.psyli.fi/suomen-psykologiliiton-lausunto-sosiaali-ja-terveysvaliokunnalle/

Tunmer, W., & Greaney, K. (2010). Defining dyslexia. *Journal of Learning Disabilities*, 43(3), 229–243. https://doi.org/10.1177/0022219409345009

Turunen, K., Tuulio-Henriksson, A. & Poutiainen, E. (2019). E. Kelan harkinnanvaraisen neuropsykologisen kuntoutuksen toteutuminen ja vaikutukset [Implementation and impacts of Kela-provided discretionary neuropsychological rehabilitation]. Helsinki: Social Insurance Institution of Finland, Social security and health reports 17, 2019. https://helda.helsinki.fi/server/api/core/bitstreams/9294af59-861b-4f87-939f-2e2ac8281c7d/content

Vanttaja, M. (2005). Koulutuksesta ja työstä karsiutuneiden nuorten kotitaustan ja myöhempien elämänvaiheiden tarkastelua. [Examining the home background and later life of young people who have dropped out of education and employment]. *Yhteiskuntapolitiikka*, 70(4), 411-416. https://urn.fi/URN:NBN:fi-fe201209117140

Zajacova, A., & Lawrence, E. M. (2018). The relationship between education and health: Reducing disparities through a contextual approach. *Annual Review of Public Health,* 39, 273–289. https://doi.org/10.1146/annurev-publhealth-031816-044628