Why Become a Maths or Science Teacher in Finland?

An Empirical Study of Mathematics and Science Subject Students' Career Choice Motives and Motivational Development during Teacher Education

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Abstract

This thesis aims to investigate the initial motivation and motivational development of mathematics and science students and student teachers in response to the impending shortage of subject teachers in Finland. For this purpose, students' motivation for teaching and student teachers' motivational development were assessed in a two-part mixed-method study. First, an online survey was conducted among 50 first-year mathematics and science students to explore their intention to become teachers as well as their motivations for and perceptions of teaching. The results show that students consider intrinsic value, prior teaching and learning experiences, and perceived teaching abilities as most relevant for the career choice of teaching. The teaching profession is perceived as high in demand and lower in return. Differences in motivation and perceptions were partly found in relation to the intention to pursue teacher education. Second, in semi-structured interviews with seven student teachers, motivational development was found to shift especially during the pedagogical studies, with supportive supervising teachers, fellow students, and perceived professional competence being positively related to motivation for teaching. The findings suggest that both initial motivation and motivational development are crucial for entry into the teaching profession. Future research should address the limitations of small convenience samples and the unsatisfactory psychometric quality of survey instruments by conducting longitudinal studies with larger samples from different Finnish universities.

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1 Shortage of mathematics and science subject teachers in Finland

In recent years, increased international attention has been given to the importance of attracting talented individuals into teacher education and the teaching profession (Watt & Richardson, 2012). Despite this increased international attention, acute or emerging teacher shortages are a recurring concern in many countries, according to the Organisation for Economic Co-operation and Development (OECD, 2005, 2014, 2020; Santiago, 2002). In this context, teacher shortages can be defined as an imbalance between the demand for teachers in certain subjects, for certain types of schools, or in the education system in general, and the supply of well-trained teachers (Santiago, 2002). According to Rots et al. (2012), a shortage of well-qualified teaching workforce may result from too few individuals choosing teacher training and entering the teaching profession, or too many teachers leaving the profession due to career changes or retirement. In consequence, teacher shortage can result in poorer quality of instruction and hence decreased literacy outcomes for learners. In the event of the persistence of an acute teacher shortage, it may even lead to economic disadvantages for a country.

In comparison to many other education systems, Finland's education system has not yet suffered an acute shortage of teachers. Instead, "due to the popularity of teaching and becoming a teacher, only Finland's best and most committed are able to realize those professional dreams" (Sahlberg, 2015, p. 109). Hence, Finland has long been in the favoured position of selecting the most promising candidates for teacher education and the teaching profession. However, it has become apparent in recent years that there is not only an increasing shortage of qualified teachers in early childhood and special education but also that a decreasing number of students of mathematics and sciences choose to become subject teachers (Moilanen & Neittaanmäki, 2021; Nissinen & Välijärvi, 2018; Kumpulainen, 2017).

Strikingly, Moilanen and Neittaanmäki's (2021) research found that the number of student teachers in mathematics, chemistry, and physics has decreased significantly since 2010, with a sharp decline since 2017. According to the authors, a continuation of the downward trend in the recruitment of future teachers in mathematics and science subjects could threaten Finland's competitiveness in critical science sectors. Hence, investigating the reasons for this shortage of subject teachers is crucial to ensure the future education of pupils in science subjects and the competitiveness of Finnish science sectors.

One way to address the teacher shortage is to examine the motivations behind individuals' decisions to become teachers (Watt & Richardson, 2012). However, in Finland, where subject

teacher education graduates can pursue careers outside school, it is also crucial to understand the impact of the experiences gained in teacher education on their motivation to become subject teachers of mathematics and science. Therefore, the purpose of this thesis is to investigate the initial motivation of students and the motivational development of student teachers of mathematics and sciences.

Specifically, in this study, the motivations, and perceptions of first-year mathematics and science students regarding the teaching profession are examined in relation to their intention to enrol in teacher education. For this purpose, the FIT-Choice scale developed by Watt and Richardson (2007) is used. Furthermore, the motivational development within teacher training will be investigated using semi-structured interviews with student teachers of mathematics and science subjects during or after their pedagogical studies at the end of teacher education. By investigating the reasons why individuals choose to become subject teachers of mathematics and science, this study aims to inform effective measures to address the shortage of mathematics and science subject teachers in Finland.

This thesis consists of six chapters. The first chapter provides a review of the literature on initial motivation for teaching and motivation development of student teachers first in general and then applied to the Finnish education system. At the end of the chapter, the gaps in the existing research on motivation in mathematics and science teachers in Finland are described and the research questions of this thesis are developed. The second chapter presents the methodology, with a separate section for the quantitative and qualitative methods, reflecting the mixed-methods design used. Chapter three describes the research findings in detail, showing first quantitative and then qualitative results. In the subsequent discussion chapter, the results are summarised and interpreted both individually and in combination. The discussion also includes limitations, recommendations for future research, and practical implications. A conclusion is provided at the end of this thesis.

2   Theoretical background

Motivation for teaching in the Finnish education context is investigated based on previous research on teacher motivation. To set the scene for this investigation, this chapter begins with a comprehensive literature review of the theoretical and empirical research related to teacher motivation, aiming to provide a thorough understanding of the current research and describe specific theoretical concepts of initial motivation and motivation development for teaching. Subsequentially, the focus shifts to the Finnish system, identifying research gaps and formulating the research questions for this thesis.

2.1   Definition of central research terms

To clarify the focus of this thesis, essential terms for this thesis are defined in this first section of the chapter.

2.1.1 Career

The term *career* originates from the French word "carriere", which generally referred to a road or a course of running. Only from the 19th century onwards, career was used as a term to describe someone's course of professional life (Harper, 2022). Ever since the term career commonly explains a series of individual occupational steps that contribute to professional advancement and increased status. Indeed, a general dictionary definition of career is as follows: "Career is a field for or a pursuit of ongoing, progressive achievement, especially in public, professional or business life" (Merriam-Webster, 2022). While general definitions of career focus on the aspect of professional advancement, the meaning in the research literature differs depending on whether the focus is on career development or career choice (Wang, 2019).

Researchers focusing on career development, such as Arthur, Hall, and Lawrence (1989) define a career as an "evolving sequence of a person's work experiences over time" (p. 8). While this definition is criticised for its restriction to development within the work-life, other career development researchers extend the career definition to include activities prior to and subsequently to the occupation and their significance for a person's various life stages and social environment (Patton & McMahon, 2014). Instead, in a career development glossary for career education, Super (1976) defines a career as a "sequence of major positions occupied by a person throughout his [or her] pre-occupational, occupational, and post-occupational life" (p. 20). These positions are those that are on the one hand work-related, such as those

concerning education and studies, employment, and pension. On the other hand, they also refer to social roles in the family and society.

More recent research focusing on career choice underlines the role of the individual, who ascribes meaning to a career through their personal development. What is distinctive about this approach to career is that it is understood as a person's individual choice (Wang, 2019). The focus on the individuum is also reflected in Savickas' (2002) definition, which states that "career denotes a reflection on the course of one's vocational behavior, rather than vocational behavior itself" (p. 383). Accordingly, to understand a person's career choice, their reflections on the course of their vocational behaviour need to be considered. Similarly, Patton and McMahon (1999) assume that career choices are shaped by individuals and depend on their career-specific perceptions and attitudes as well as "the pattern of influences that coexist in an individual's life over time" (p. 170). According to Blustein (2006), career choice should be viewed from a more holistic standpoint considering individual aspects such as gender and socio-economic background, as well as contextual factors like social, cultural, economic, and political aspects that may have an influence on individual career choice and development.

Overall, research literature indicates the existence of different understandings of the term career that have evolved over time. In this context, Patton, and McMahon (2014) suggest that conceptualisations of career, career choice, and career development are always a reflection of the temporal circumstances in which they were developed and therefore need to be continuously refined.

Transferred to the teaching profession, linked to these understandings of career, career choice before, and career development during higher education are understood in the context of this thesis as a complex, individual process. The particular focus within this thesis on career choice and development during teacher education is justified by minimal opportunities for further qualifications within the teaching profession. Although teachers receive further education within their profession, for example through annual in-service training, training does not lead to new professional qualifications or changed career paths (Niemi, 2015). Moreover, teacher surveys indicate that the majority of individuals choosing the teaching profession in Finland remain in the teaching profession throughout their careers (e.g. OECD, 2013).

2.1.2 Motivation for teaching

Motivation is derived from the Latin term "movere", which means to move, and is considered one of the essential forces underlying human behaviour (Neta & Haas, 2019). Despite motivation and motivational processes being one of the most researched topics in psychology and education, it is defined diversely in the literature (Han & Yin, 2016). According to a definition by Weinstein and DeHaan (2014), "[m]otivational processes are responsible for initiating and directing human activity; they stimulate behavior, generate and increase commitment to a task, and guide actions toward specific purposes or goals" (p. 3). In this definition, it is described that motivation comprises the process from the initiation of action to the execution of individual human behaviour. More precisely, two dimensions of motivation are distinguished, namely direction and magnitude (Dörnyei, 2001; Dörnyei & Ushioda, 2011). Motivation, therefore, forms the basis for the initiation of a behaviour and for its duration and intensity.

Applied to teacher education and the teaching profession, Sinclair (2008) defines motivation as determining "what attracts individuals to the teaching profession, how long they stay in teacher education and subsequently in the teaching profession, and the extent to which they engage in their education and in the teaching profession" (p. 37). Thus, whether a person chooses to apply to the teacher education, how long the person remains in it and how intensively the person is devoted to it may be determined by motivational processes (Sinclair, 2008). Especially concerning initial or entry motivation, which is also called career choice motivation in the literature, Sinclair (2008) highlights that this motivation is only considered as the first step into the teaching profession and that especially teacher education is central to maintaining or changing motivation. Furthermore, motivation is necessary to enter and stay in the teaching profession and to dedicate oneself intensively to teaching (Sinclair, 2008). Consequently, motivation for teaching can be divided into two phases: 1) the initial motivation that leads to the teacher's career choice, and 2) the sustained motivation resulting in the maintenance of the career choice.

In the context of this thesis, exploring motives for choosing a teaching profession means identifying the motivational factors that influence the consideration and decision of prospective science and mathematics student teachers to enter teacher education, as well as those that contribute to maintaining motivation to enter the teaching profession. In the literature, the terms career choice motives, motivations, and motivational factors also refer to

reasons and arguments that explain the choice of a career in teaching (Trojer, 2018). Hence, the terms are used as synonyms in this thesis.

2.2   Research on motivation for teaching

Motivation for teaching has only recently become the focus of research in teacher education and educational psychology. Since the beginning of this millennium, teacher motivation has become a central research topic, driven by an increased interest in finding the causes of acute and emerging teacher shortages in many countries around the world. In 2008, research on teacher motivation was even referred to as the *"Zeitgeist* of interest" in the special issue of the journal *Learning and Instruction* by researchers Watt and Richardson (2008a, p. 405). Early research commonly focused on the initial motivation to choose a career in teaching. Research interest in the maintenance and change of motivation for the teaching profession among student teachers and teachers has emerged only recently (Han & Yin, 2016). Based on the two defined stages of motivation for teaching, the following sections will review the literature on initial motivation for a career as a teacher and on motivation maintenance focusing on student teachers.

2.3   Initial motivation for choosing teaching as a career

The following section focuses on the initial teacher motivation. This section begins with a review of early research on teachers' career choice motivation. This is followed by a critique of the early research approach and a progression to teacher motivation research based on the FIT-Choice model introduced by Watt and Richardson (2007).

2.3.1 Early research on teacher's career choice motivation

Since the 1960s, research has increasingly been concerned with questions of what motivates young individuals to choose teaching as a career and how they perceive the teaching profession (Richards, 1960; Richardson & Watt, 2014b; Watt & Richardson, 2008b). One of the first contributions to teacher motivation research was by Rachel Richards, who investigated students' attitudes toward choosing teaching as a career in 1958. In this study, Richards administrated a questionnaire called "attitude inventory" to new teacher students in the College of Education at Ohio State University. As a result of the study "the majority of students stated that they choose teaching as a profession because they wanted to help children and anticipated personal enjoyment in the work" (Richards, 1960, p. 380).

Later on, Brookhart and Freeman (1992) published a review study, in which they analysed 44 US studies on the characteristics of beginning student teachers from 1960 to 1990. In addition to other characteristics of the student teachers, the researchers compared motivation-related results of the individual studies in the variable category of motivation to teach and career expectations. The analysis showed that a large proportion of the studies that surveyed teacher motivation used questionnaires. Despite different formulations and different questionnaire contents, the results of the review suggested a "consistent pattern has been that altruistic, service-oriented goals and other intrinsic sources of motivation [as] the primary reasons entering teacher candidates report for why they chose careers in teaching" (Brookhart & Freeman, 1992, p. 46). In the review study, the authors emphasise a finding of Book and Freeman's study (1986), showing motivational differences in student teachers for primary and secondary school. Whereas student teachers aiming to work at primary school indicate working with children as the primary reason for their career choice, secondary candidates' career choice motivation is more likely subject focused and influenced by former teachers (Brookhart & Freeman, 1992). In retrospect, Brookhart and Freeman's review study is considered seminal for subsequent teacher motivation research (Richardson & Watt, 2014a).

Indeed, this review study was followed by a series of research in various education systems that explored aspects of what motivates student teachers to a career in teaching (Richardson & Watt, 2010; Wang, 2019). Research over the last decades has shown that the main reasons or motives for choosing teaching as a profession can be broadly categorised as intrinsic, altruistic, and extrinsic (Bastick, 2000; Bruinsma & Jansen, 2010; Kyriacou et al., 2003; Kyriacou & Coulthard, 2000; Moran et al., 2001; Struyven et al., 2013; Watt et al., 2007; Yüce et al., 2013).

Intrinsic motives include factors that stem from within the person, such as personal interests, aspirations, and passions. These internal factors are targeted at the teaching profession itself, such as the desire to work with children or adolescents, the joy of teaching, or the professional interest in the teaching subjects (Kyriacou & Coulthard, 2000; Struyven et al., 2013; Wang, 2019). *Altruistic motives* relate to the social value of the teaching profession, which contributes to pursuing a career as a teacher. This category of motives includes the attitude that the teaching profession makes an important contribution to improving society or the intention to contribute to society by helping children and adolescents in their development (Kyriacou & Coulthard, 2000; Struyven et al., 2013; Wang, 2019). In contrast, *extrinsic motives* that underlie career choice are those that are not inherently related to the job itself but

to the working conditions of the teaching profession, such as salary level, job security, length of vacation, and status (Kyriacou & Coulthard, 2000; Struyven et al., 2013; Wang, 2019).

These three motivational categories for choosing a career as a teacher are still relevant today, as the recent International Teaching and Learning Survey (TALIS) conducted by the Organisation for Economic Co-operation and Development (OECD, 2018) confirms. In this survey, most teachers from all participating OECD countries and economies retrospectively identified the opportunity to impact children's development and contribute to society as an important motive for entering the profession. This finding indicates that altruistic reasons remain central to choosing the teaching profession. Moreover, in this TALIS survey, around two-thirds of teachers said that extrinsic factors, such as economic aspects and the working conditions in the teaching profession, were important to them when choosing a career. However, this proportion "is higher in countries where teachers are highly valued in society and their economic status is better than that of other professions" (OECD, 2018, p. 112). For example, a stable income and a linear career path were chosen by three-quarters of the Finnish teachers surveyed as the second and third most important career choice factors. These results underline that extrinsic reasons for a career choice can be important and depend on the specific characteristics of the teaching profession in the respective education system. Moreover, the findings can also be interpreted as an indication that in different education systems, individuals choose the teaching profession for different reasons.

2.3.2 Critique of early research on teacher's career choice motivation

Despite the topicality and the consensus among researchers regarding these three main career choice motivations for teaching, the early heterogeneous research approach in teacher motivation research has been criticised in the literature. The critique of early research addresses problems of theoretical conception and operationalisation, the methodological approach, and the samples studied.

An overarching theoretical problem is that for a long time, teacher education research and research on motivation and career choice had developed independently of each other. As a result, conceptions gained in the two research areas were not linked, and many findings regarding career choices in other professions, have not been applied to research on teacher motivation (Richardson & Watt, 2014b). Furthermore, Richardson and Watt stress that for research to effectively capture "underlying psychological processes concerning motivations for choosing to become a teacher, there is a need for robust measures, founded upon explicit

theoretical frameworks, to encompass a comprehensive set of motivations" (2010, p. 148). However, previous studies have not consistently defined what intrinsic, altruistic, and extrinsic motives are and how they are operationalised (Richardson & Watt, 2006, 2010, 2014b). For instance, some studies consider the desire to work with children as an intrinsic motive (e.g. Young, 1995), while other studies consider this desire as an altruistic motive (Richardson & Watt, 2014b; Yong, 1995). Thus, due to a lack of precise definitions and an integrative theoretical framework, the findings of previous studies can only be compared to a limited extent.

According to Richardson and Watt (2014b), difficulties in definition and operationalisation were exacerbated "by researchers using different survey instruments, with little or no information on reporting of construct validity or reliability and over-reliance on raw frequency counts" (p. 3). Particularly the use of different measurement instruments poses difficulties for the comparison of findings collected in different education contexts (König et al., 2013).

However, not only the theoretical and methodological approach to early teacher motivation research has been criticised, but also the samples of previous studies. For instance, König and his colleagues (2013) note that previous national and international studies have been based on local, non-representative occasional samples. Moreover, many studies were conducted in the North American education context and their findings can only be transferred to other education systems to a limited degree (Watt & Richardson, 2008b).

Based on these various shortcomings of early teacher motivation research, researchers such as König and colleagues (2013) conclude that there has been a "lack of a common, theoretical framework of reference as well as an empirically tested assessment instrument" (p.555).

2.3.3 Research on motivation for pursuing teaching as a career using FIT-Choice

To address the lack of a theoretical framework for teachers' career choice motives, Watt, and Richardson (2007) proposed a theoretical model called *Motivational Factors Influencing Teaching Choice* (FIT-Choice). The FIT-Choice model aims to link teacher education research with psychological motivation research by building on the empirical findings that individuals pursue the teaching career for intrinsic, extrinsic, and altruistic motives, and drawing on the theoretical framework of expectancy-value theory (Eccles, 2005; Richardson & Watt, 2006, 2014b; Watt & Richardson, 2007). This FIT-Choice model provides the basis

for the FIT-Choice scale; a survey instrument that is intended to provide comparable and comprehensive measurements of motivational factors influencing the choice of teaching as a career (Watt & Richardson, 2007).

Theoretical underpinning of the FIT-Choice model

The *expectancy-value theory* was first introduced into the field of achievement motivation research by Atkinson (1957) and later expanded to the field of educational psychology by Eccles and colleagues (Eccles, 2005; Eccles et al., 1983; Eccles & Wigfield, 1995; Wigfield & Eccles, 2000). With respect to achievement motivation and career choice, expectancy-value theorists assume that educational, occupational, and other achievement-related decisions depend on individual expectations for success and the value the individual ascribes to a task (Eccles, 2005; Eccles & Wigfield 1995, Richardson & Watt, 2014, Wigfield & Eccles, 2000).

According to Wigfield and Eccles (2000), the value component can be divided into four subcomponents: attainment value, utility value, intrinsic value, and cost value. *Attainment value* expresses the importance of achieving one's personal goals when solving a task. *Intrinsic value* stands for the enjoyment or interest in the task. *Utility value* represents the importance of the task for one's personal future. Lastly, the less studied *cost value* symbolises the effort and time required to solve the task or the emotional burden the task raises (Eccles et al. 1983 as in Wigfield & Eccles, 2000).

The theoretical expectancy-value model was priorly applied to study motivation connected to various academic disciplines and career choices for other professions. Although the expectancy-value theory had been used in education and career choice research, the model had not yet been applied to study teachers' career choice motivation. Nonetheless, previous applications to career choice research of other professions were decisive for embedding the expectancy-value theory in an integrative model "to guide systematic inquiry into the primary motivations of why people choose to become teachers" (Richardson & Watt, 2014b, p. 5). Richardson and Watt (2014b) note that in previous teacher education research, little attention had been paid to intrinsic value and the perception of individual job-related abilities, although these have been emphasised as important factors in occupational decisions in previous literature on motivation and career choice. By theoretically combining teacher education research with motivational and sociological literature, the FIT-Choice model integrates altruistic, extrinsic, and intrinsic motives and expectancy-value theory to explain the choice to become a teacher (Richardson & Watt, 2014b).

Structure of the FIT-Choice model
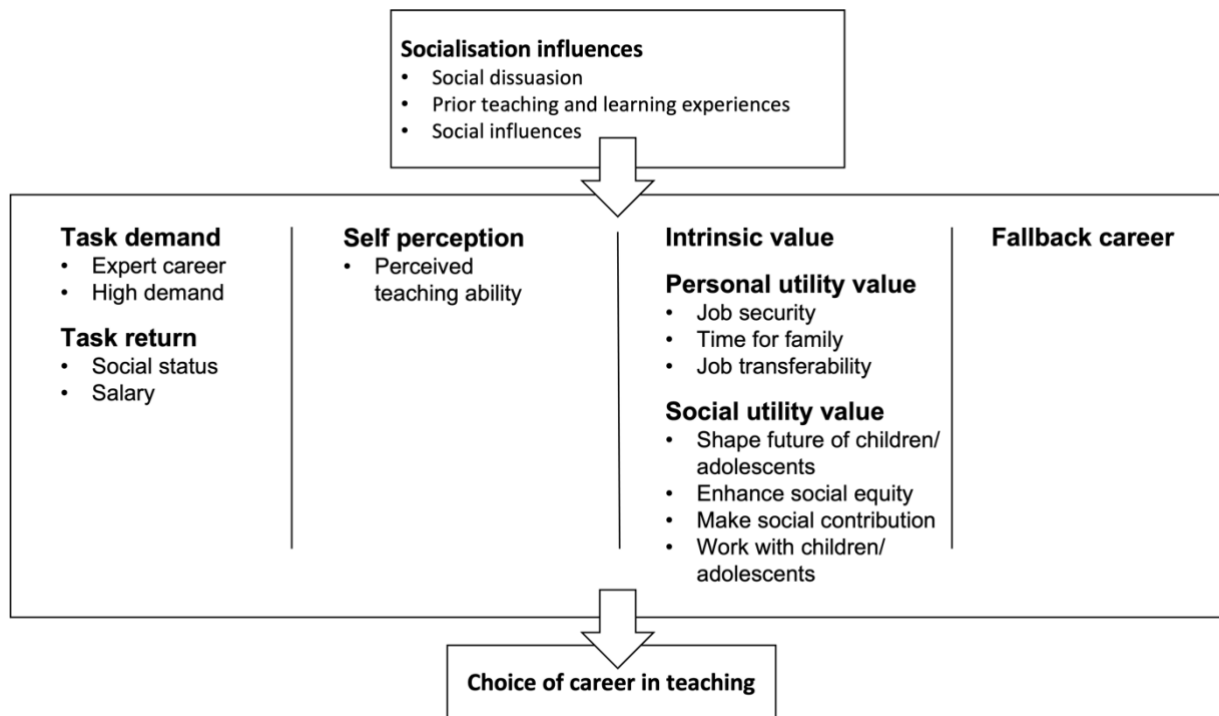
Figure 1. Theoretical FIT-Choice model.

(Author's illustration based on Richardson & Watt, 2014b, p. 6. Permission to use illustration was granted by Taylor and Francis Group.)

The FIT-Choice model, which "was developed to assess the primary motivations of teachers to teach" (Watt & Richardson, 2012, p. 186), encompasses a sequence of psychological mechanisms that interrelate in a career decision for the teaching profession. As shown in Figure 1, the sequencing begins with the *socialisation influences* preceding the career choice process. Socialisation influences consist of *social influences, prior teaching and learning experiences,* and *social dissuasion*. Social influences represent the opinions of family, friends, and peers in favour of a career in teaching. Prior teaching and learning experiences reflect the person's learning experiences with teachers acting as role models and teaching practices, for example from a person's school education. Social dissuasion is the individual's perception of discouragement against pursuing the teaching profession (Goller et al., 2019; Watt & Richardson, 2007). Hence, the model proposes that an individual's decision to pursue a teaching career is shaped by the opinions of their social surrounding about the profession and their individual experiences.

These socialisation influences are followed by more proximal factors affecting the decision for a career in teaching, which can be found from the centre of the model in Figure 1. These

proximal factors comprise various motives for and perceptions of teaching. Proximal perceptions of teaching include *task demand,* representing a person's understanding of the expertise required for and the difficulty of teaching and *task return*, determining the individual gains connected to the teaching profession, such as social status and salary (Richardson & Watt, 2014).

Proximal factors of motivation include *self-perception*, *values,* and *fallback career*. Self-perception with the subordination of *perceived teaching abilities* stands for a person's anticipation of their teaching capabilities. Regarding the value of teaching, a distinction is made between *intrinsic*, *personal*, and *social utility values*. With the inclusion of intrinsic, personal and social utility values, Watt and Richardson (2007) combine motivation research and teacher education research, as personal utility value represents extrinsic motives, and the social utility value embeds altruistic motives for becoming a teacher. According to Richardson and Watt (2014b), the personal utility value is further subdivided into "the first-order constructs of Job security, Time for family, and Job transferability; Social utility value contains Shape future of children/adolescents, Enhance social equity, Make social contribution, and Work with children/adolescents" (p. 7). In addition, the model further accounts for individuals who may choose the teaching profession as a fallback career, which means that individuals were unable to obtain a placement in their desired career or were unable to pursue their first-choice career for other reasons (Watt et al., 2012).

In total, the FIT-Choice model considers both individual and socialisation factors, which in their interaction lead to a career choice for teaching. By considering individual and socialisation factors, the framework model aligns with Blustein's call (2006) for a comprehensive perspective on career decisions. Richardson and Watt (2014) highlight, that "all parts of the model are proposed to work together to predict choice of a teaching career and professional engagement outcomes" (p.7). However, some researchers speculate that some factors may have a stronger influence on the career choice to become a teacher than others. For example, Trojer (2018) suggests in relation to task demand and task return that the perception of high task demands associated with the teaching profession may influence the career decision for or against teaching more strongly than the prospect of status and salary. Hence, it can be argued that the precise weighing of the various factors of the model on career decisions in different education contexts is still insufficiently researched.

The FIT-Choice model represented in Figure 1 was empirically validated in the form of the FIT-Choice scale which measures career choice motives for teaching and expectations related to the profession. Following the theoretical distinction between motivations for teaching and perceptions of the teaching profession as influencing factors for the career choice to become a teacher, the FIT-Choice scale is divided into two subscales of *motivations for teaching* and *perceptions of teaching*. All items of the FIT-Choice scale are measured using a 7-point Likert scale (Watt & Richardson, 2007).

Application and validation of the FIT-Choice scale

The FIT-Choice scale was first applied and validated by Richardson and Watt (2006) in the Australian education context. In this first application of the FIT-Choice scale in which 1653 student teachers from three Australian universities were surveyed, it was found that the strongest motivations for prospective teachers' career choice of teaching were perceived teaching ability and the intrinsic value of teaching. Further, social utility values, such as the desire to make a social contribution, shape the future, and work with children/youth, were identified as the most important motivations. In contrast, Australian student teachers reported teaching as a fallback career and social influences from others as the least influential motives for their career choice. Nevertheless, the teaching profession was perceived by student teachers as a high-demand and difficult profession, which is characterised by a heavy workload, high emotional effort, and hard work, but offers low task return in terms of social status and salary (Richardson & Watt, 2006).

Against the background of a teacher shortage in mathematics and science subjects in Australia, Watt et al. (2007) conducted an additional analysis of motivations to become teachers and perceptions of the teaching profession of prospective Science, Technology, Engineering, and Mathematics (STEM) teachers based on the initial study in Australia. This subsample included 245 first-year teacher students in STEM study programmes at three Australian universities. Referring to the motivations to become a teacher, similar response patterns emerged in comparison to the publication by Richardson and Watt (2006), in which the responses of teachers across different teaching subjects were analysed. Similarly, for STEM teacher students, perceived teaching ability, intrinsic value, the desire to make a social contribution, and to shape the future of students were rated as crucial motives for choosing teaching as a career (Watt et al., 2007). In addition, the role of prior teaching and learning experiences was assessed as important for career choice. Comparable to the analysis across

student teachers of all subjects published by Richardson and Watt (2006), teaching as a fallback career and social influence by others was also considered to have little effect on the career decision of prospective STEM teachers. More detailed analysis also revealed only a few significant differences in teaching motivation between bachelor's and master's students and between female and male students of STEM subjects (Watt et al., 2007). Furthermore, STEM student teachers also hardly differed in their perceptions of the teaching profession compared to the overall sample of all student teachers. Similar to the overall sample, students of STEM subjects also perceive teaching as a demanding profession that gives little in return in terms of status and salary. Again, concerning the perception of the teaching profession, minor gender- and degree-related differences in the response patterns were identified (Watt et al., 2007).

After the initial application and validation of the FIT-Choice scale, it was translated into different languages and applied in various countries to assess the motivational factors of student teachers and teachers in the respective education contexts. For example, the FIT-Choice scale has been used in Croatia (Jugović et al., 2012), Germany (König & Rothland, 2012), the Netherlands (Fokkens-Bruinsma & Canrinus, 2012), Turkey (Kilinç et al., 2012), Ireland (Hennessy & Lynch, 2016), and Ghana (Salifu et al., 2018). Furthermore, the FIT-Choice scale has been applied in international comparative studies assessing the initial career choice motives and perceptions of the teaching profession of prospective teachers in different education contexts, including Australia, the USA, Germany, and Norway (Watt et al., 2012); China and the USA (Lin et al., 2012); Canada and Oman (Klassen et al., 2011). Regarding the Finnish context, according to current knowledge, three recent international comparative studies have been conducted with teacher students from Finland and Germany (Goller et al., 2019); Finland, Sweden, and the USA (Giersch et al., 2021), and Estonia and Finland (Taimalu et al., 2021). Motivational research of prospective teachers in Finland is discussed in more detail in section 2.5.5 of this thesis.

Overall, based on the theoretical foundation and empirical findings, it can be assumed that the FIT-Choice model is a valuable, theoretically sound, psychometrically reliable framework for studying the initial motivation for choosing a career in teaching.

2.4 Motivational developments during teacher education

As previously discussed in this thesis, career choice is considered a continuous, complex, and individual process. In section 2.1.2, two distinct stages of motivation for teaching have been

outlined, namely initial and sustaining motivation. This suggests that not only initial motivations for and perceptions of teaching are crucial, but also academic and pedagogical training may influence the motivational development of student teachers.

In an early article titled *The Motivation to Teach* published in 1977, Bess remarked in reference to teachers in higher education that "early motivation could not predict the maintenance of motivation with teaching as a career, and initial enthusiasm for teaching would decrease" (as cited in Han & Yin, 2016, p. 3). Despite early indications of changes in initial teacher motivation over time, research on possible changes over the course of teacher education has been lacking for a long time. For example, Sinclair noted in 2008 that while a considerable amount of research has examined initial motivation for teaching, little is known about how theoretical and practical teacher education affects motivation and commitment to the teaching profession. In a longitudinal study, she compared the answers to a questionnaire given by 211 student teachers at the beginning of their first semester of study and then again at the end of their first semester after their first practical experience in school. In the questionnaire, the student teachers were asked by means of open questions, about the extent and reasons for the change in their motivation and commitment to the teaching profession. The responses showed a change in motivation for 75% of the student teachers, although not statistically significant, and a change in their commitment to the teaching profession for around 65%. The qualitative data suggested that "almost all student teachers increased in their motivation and commitment to teaching, and had their initial career choice confirmed over this period" (Sinclair, 2008, p. 96). Sinclair concludes based on the study that student teachers begin teacher education with specific motivations and expectations regarding the teaching profession, however, these initial motivations and expectations are tested and re-evaluated during theoretical and practical teacher training (Sinclair, 2008). Nevertheless, Sinclair (2008), as well as other researchers (Richardson & Watt, 2010; Roness & Smith, 2010) call for further studies to be conducted to understand the impact of teacher education experiences on student teachers' motivation.

This call was addressed by Rots et al. (2012), who conducted a qualitative research study on professional development in Belgian student teachers. This study focused on how student teachers' perception of the teaching profession and themselves in the teaching role developed and evolved throughout their teacher education. The researchers assume a continuous professional development of teachers, which is based on the theoretical conceptualisation of the *personal interpretative framework* introduced by Kelchtermans (1993, 2009).

2.4.1 Theoretical conceptionalisation of teacher's professional development
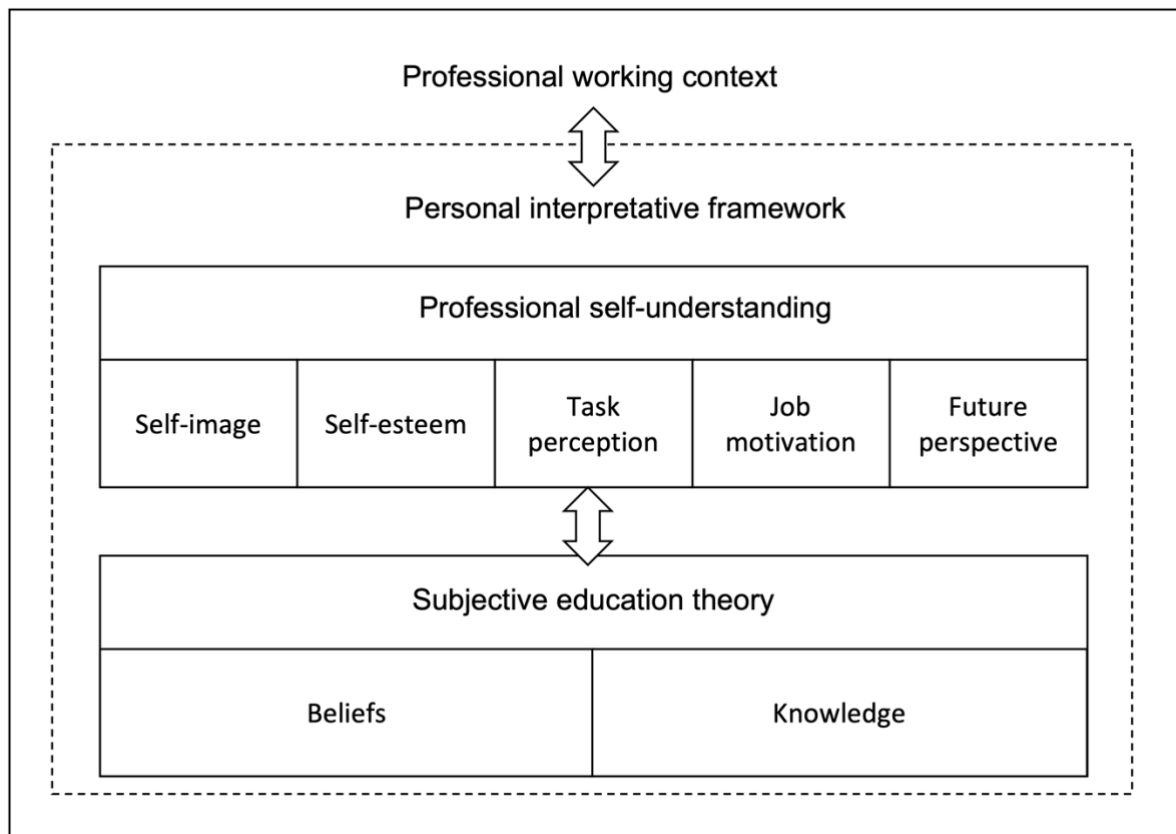
Figure 2. Personal interpretative framework.
(Author's illustration based on Kelchtermans, 1993; Loosveld et al., 2021, p. 2)

Kelchtermans (2009) defines the personal interpretative framework as "a set of cognitions, of mental representations that operates as a lens through which teachers look at their job, give meaning to it and act in it" (p. 260). The framework develops from the continuous interaction between student teachers or teachers and their professional context, which is indicated by a double arrow in Figure 2. The function of the framework is to guide interpretations and actions in particular situations embedded in the professional context. From meaningful situational interactions in the corresponding context, a teacher's personal interpretive framework is maintained and further developed. Thus, the personal interpretive framework is always both the condition and the result of a situational interaction with the context and "represents the - always preliminary - *mental sediment* of teachers' learning and developing over time" (Kelchtermans, 2009, p. 261). Therefore, teachers continue to develop this framework throughout their teacher education and careers in the school context.

As shown in Figure 2, the personal interpretation framework combines two theoretical approaches, *self-understanding* and *subjective educational theory*, which influence each other.

According to Kelchtermans (2009), these theoretical concepts are based on teacher-thinking research and narrative-biographical approach to teacher's development.

Self-understanding

Kelchtermans' (1993) concept of self-understanding, consists of five components: *self-image*, *self-esteem*, *task perception*, *job motivation*, and *future perspective*.

Self-image is the descriptive component of the self-understanding concept. It refers to how teachers perceive and define themselves in their professional roles. Although it is primarily based on the teacher's own self-perception, it is strongly influenced by the reflections of others. Therefore, the way others perceive a teacher plays an important role in shaping their self-image (Kelchtermans, 2009).

Closely related to self-image is the evaluative component of *self-esteem*. Self-esteem involves how teachers evaluate and assess their actual professional performance. Although feedback from others is important to the evaluation process and the development of self-esteem, this information is filtered and interpreted by the teacher. In doing so, certain feedback, such as that from pupils, is considered more valuable or important. The evaluative component allows teachers to assess their professional performance and show their appreciation for it, which can be understood as the emotional dimension in the teaching profession (Kelchtermans, 2009; Yağan et al., 2022).

Referring to Kelchtermans (2009) „self-esteem as the evaluative component has to be understood as intertwined with the normative component of self-understanding: the *task perception*" (p. 262). Teachers' task perceptions refer to their views on the professional approach, tasks, and responsibilities required to do their job well. It represents a teacher's personal response to questions such as: What actions do I need to take to be a competent teacher? What essential tasks should I perform in order to feel that I am doing a good job? Which duties do I recognise as legitimate and which do I reject as part of my responsibility? This normative component illustrates that teaching is not a neutral endeavour but involves value-based decisions and moral considerations (Kelchtermans, 2009; Yağan et al., 2022).

The conative component of teachers' self-understanding is their *job motivation.* Job motivation encompasses motivational factors that drive individuals to pursue, remain in, or exit the teaching profession. According to Kelchterman's understanding, job motivation is decisively influenced by both the perception of work and the working conditions that enable a

teacher to work and act according to this personal normative programme. Job motivation, in this view, can change and evolve over time (Kelchtermans, 2009).

The concept of self-perception includes the aspect of *future perspective*, which represents teachers' expectations of their professional future. This perspective highlights the dynamic nature of the concept of self-understanding, where teachers' present professional behaviour is shaped by their significant past experiences and their anticipated future expectations Kelchtermans, 2009; Yağan et al., 2022)

All in all, the five components of self-understanding can be distinguished analytically, but they are also interdependent and interconnected (Kelchtermans, 2009). Therefore, the strength of the self-understanding concept is that it is both integrative and differentiated. As such, the concept presents the dynamic nature and contextual embeddedness of a teacher's sense of self, while providing an analytical framework for understanding how the *self* informs all facets of teaching (Kelchtermans, 2009).

Subjective educational theory

The concept of self-understanding can be further connected to the *subjective educational theory* by Kelchtermans (1993), which represents teachers' knowledge and beliefs about teaching as shown in Figure 2 (Rots et al., 2012). The *knowledge* component of the subjective educational theory includes teachers' knowledge about pedagogy, subject didactics, and the subject matter, which they have acquired formally or informally in teacher training, professional practice, in-service training, or reading of professional literature (Kelchtermans, 2009). In contrast to the impersonal knowledge component, beliefs "refer to more personal, idiosyncratic convictions built up through different career experiences" (Kelchtermans, 2009, 264). With reference to Kelchtermans (2009), subjective educational theory guides teachers' cognition and actions in specific situations in their work context.

The combination of both concepts comprises cognitions, albeit dynamically evolving, and results in the personal interpretive framework through which teachers perceive and interpret their job and draw conclusions for their future work. This personal interpretive framework may be expanded or revised by critical events, phases, or individuals in the professional work context (Kelchtermans, 1993).

2.4.2 Application of the personal interpretative framework to student teachers

As mentioned above, Rots and her colleagues (2012) have applied and specified Kelchtermans' conceptualisation of teacher development to teacher education. The researchers suggest that teachers develop their personal interpretive framework already before and during teacher education. During teacher education, particularly critical events, phases, or persons in practical training periods at school can prove to be very influential socialisation experiences that can broaden or influence the personal interpretative framework (Rots et al., 2012; Smagorinsky et al., 2004). In these practical training periods, student teachers take on the role of a teacher for the first time, they test their knowledge and reflect on their job motivation, their commitment to the teaching profession, and on themselves as a teacher (Bullough & Young, 2002; Rots et al., 2012). Conflicts between the pre-formed professional self-understanding and the subjective educational theory with the reality of the teaching profession "often lead [ ] to tensions, doubts, and possibly modifications of the personal interpretative framework" (Rots et al., 2012, p. 2). Hence, when student teachers notice in their practical teacher training in the working context of a school that their ideas about the teaching profession and themselves in the teaching role do not match the school reality, conflicts within the personal interpretive framework can occur. The consequences of this mismatch can either lead to an adjustment of the personal interpretative framework to the work reality or to a *praxis shock*, which under certain circumstances may lead to an early career change (Cole & Knowles, 1993; Rots et al., 2012).

Based on this theoretical foundation, Rots, and her colleagues (2012) conducted semi-structured interviews with student teachers in Belgium shortly before graduation to find out how student teachers' job motivation is influenced by experiences gained during teacher training leading to a certain decision about entering the profession. The analysis of the interview data indicated three major scenarios of changes in job motivation during teacher education: Students changed from low to high job motivation, from high job-nonspecific to high job-specific motivation, and from high to low job motivation. For the motivational changes, it was demonstrated that during teacher training and especially during practical teaching periods, student teachers gain experiences that change their image of themselves and the teaching profession. Rots et al. (2012) identified "(1) development of professional competence and (2) social-professional relationships in the placement school" as determinants of motivational change (p. 4).

According to Kelchtermans' personal interpretative framework (1993), student teachers strive to acquire the competencies required for their profession, including subject knowledge, teaching methodology, and social skills, in a way that is consistent with their conception of the teaching role. The feeling of being competent as a teacher was found in the study to be important for positive self-esteem and job motivation, which can result from student teachers' satisfaction with their teaching performance and recognition by others. However, positive evaluations can be fragile and the lack of efficacy in the classroom and social recognition can jeopardise "student teachers' sense of professional competence" (Rots et al., 2012, p. 5).

The development of student teachers' sense of professional self also involves their perceptions of meaningful social interactions with mentors and other staff in the school context. Rots and colleagues (2012) found in their study that building positive relationships with mentors is essential for student teachers as it enhances their self-esteem and positive attitudes toward the teaching profession. These relationships also reflect the organisational culture of the placement school. Student teachers' perceptions of collegiality within the school were influenced by how much they felt accepted as colleagues.

2.5   Subject teacher education and the teaching profession in Finland

This section serves to locate and conceptualise teacher motivation as a research topic in the Finnish education system. For this purpose, the structure of the Finnish school system with a special focus on secondary school will be presented in the first section. This will be followed by a description of teacher training and the teaching profession in general, with a particular focus on secondary school teachers in science and mathematics. The section concludes by reviewing previous research on teacher motivation and the impending shortage of teachers in mathematics and science subjects in Finland.

2.5.1   Structure of the Finnish education system and secondary education

As can be seen from the overview of the Finnish education system in Figure 3, it is a multi-layered system ranging from early childhood education to adult education. According to the Ministry of Education and Culture [OKM] (2022) the Finnish education system comprises six key elements.

Doctoral degrees
Licentiate degrees
Universities

Master's degrees
Universities

Master's degrees
Universities of Applied Sciences

Work experience 2 years

Bachelor's degrees
Universities

Bachelor's degrees
Universities of Applied Sciences

Vocational qualifications*
Vocational institutes

Specialist vocational qualifications

Further vocational qualifications

Initial vocational qualifications

Matriculation examination
General upper secondary schools

Preparatory education
for programmes leading to
an upper secondary qualification

Primary and lower secondary education
Comprehensive schools

Pre-primary education

Early childhood education and care (ECEC)

Age 18

ISCED classification: 8, 7, 6, 4, 3, 1&2, 0
EQF classification: 8, 7, 6, 5, 4, 2
Duration in years: 2, 3, 3, 1, 9, 1, 0–6
Duration of compulsory education

Duration in years: 1–1.5, 3.5–4.5, 3

Liberal adult education
Adult education centres
Folk high schools
Summer universities
Centres of learning
/Study centres
Sports institutes

Basic education in the arts
Schools of architecture,
circus,
crafts,
dance,
media,
music,
literary art,
theatre and visual arts

* Also available as apprenticeship training or by training agreement.

8/2022

Figure 3. The Finnish education system.
(Ministry of Education and Culture [OKM], 2022)

These key elements include early *childhood education and care* (ECEC), which is targeted to young children up to six years of age before compulsory schooling. ECEC is followed by one year of *pre-primary education*, which has been compulsory for all children since 2015 and is intended to ensure a good transition from early childhood to school education. After pre-primary education, children enter the nine-year compulsory *comprehensive school* (fi. peruskoulu), which is divided into primary (fi. alakoulu) and lower secondary level (fi. yläkoulu). After that, students attend *upper secondary education*, which comprises general upper secondary education (fi. lukio) or vocational training (fi. ammatikoulu). This can be followed by *higher education* at universities and universities of applied sciences. In addition, there is *adult education*, covering all levels of education (Ministry of Education and Culture [OKM], 2022).

A closer look at the structure of the Finnish education system highlights that secondary education is centrally located, and thus an important pillar in the educational pathway of pupils. The lower secondary school begins with the seventh grade of the comprehensive school. Attendance at lower secondary schools is compulsory and free of charge for all pupils. At the end of upper secondary school, all pupils are obliged to apply for post-comprehensive

schooling. "Compulsory education ends when the learner reaches the age of 18 or when they complete an upper secondary qualification (a general upper secondary qualification or a vocational qualification)" (Ministry of Education and Culture [OKM], 2022). If learners opt for general upper secondary education, they receive a general education that does not prepare them for any specific profession. A particular characteristic of general higher secondary education is that many of the subjects started in secondary school are continued and intensified. This is also the case with the education in mathematical and natural science education.

2.5.2 Mathematics and sciences teaching and learning in secondary education

Learners acquire important basic knowledge in mathematics and science subjects already in Finnish Basic Education from grades 1 to 6. According to the National Core Curriculum for Basic Education 2014 (2016), children at the primary level are introduced to mathematical thinking, learn basic principles of "numbers and operations", "algebra", "geometry and measuring" as well as "data processing, software, statistics, and probability" in the subject of mathematics (p. 399–400). In addition, basic knowledge of the natural sciences is already taught at the primary school level in the subject of environmental studies. "Environmental studies is an integrated subject which comprises the fields of knowledge of biology, geography, physics, chemistry and health education and which includes the perspective of sustainable development" (*National Core Curriculum for Basic Education 2014*, 2016 p. 185). The subject thus encompasses both the perspectives of the natural sciences and the human sciences. The teaching of environmental studies aims to provide learners with a foundation of competence in all fields of knowledge integrated into the subject. From secondary level I, that is, from grade 7, onwards the disciplines are divided into 5 individual subjects, which are health education and the four natural science subjects: biology, geography, physics, and chemistry. Mathematics is also continued and intensified in the form of a single subject (*National Core Curriculum for Basic Education 2014*, 2016).

In the subject of mathematics, pupils of grades 7 to 9 strengthen their general mathematical knowledge and skills. The aim of the teaching is to help students to deepen their knowledge of mathematical concepts and to recognise relationships between them. Referring to the Finnish National Agency for Education [OPH] (2023b), through the teaching of mathematics in general upper secondary school, students deepen, apply, and communicate their mathematical understanding and develop their mathematical skills. Specifically, Finnish

general upper secondary education has two mathematics curricula from which students can choose one: the advanced mathematics syllabus, containing 18 compulsory credits, and six optional credits, and the basic mathematics syllabus (10 compulsory and four optional credits) (Finnish National Agency for Education [OPH], 2023b).

Other scientific subjects that are of relevance in this thesis are physics and chemistry. Referring to the *National Core Curriculum for Basic Education*, 2014 "[t]he task of the subject of physics [and chemistry] is to support the development of the pupils 'scientific thinking and worldview" (2016, p. 669-670, 679). Through the teaching of physics and chemistry, lower secondary school students understand the importance of the fields of physics and technology as well as chemistry and learn fundamental concepts in theory and application. In physics at general upper secondary school, learners observe phenomena and recurring patterns of nature against the background of prior knowledge and physical laws. At the general upper secondary level, attending instruction in physics is obligatory for two credits and optional for 12 credits (Finnish National Agency for Education [OPH], 2023b). In chemistry students at the general upper secondary school "study substances, their structure and characteristics and the reactions between substances" (Finnish National Agency for Education [OPH], 2023b). In general upper secondary education, the compulsory part for chemistry amounts to two credits, and the elective part to eight credits (Finnish National Agency for Education [OPH], 2023b).

In addition, biology and geography are science-related subjects taught both in lower and general higher secondary schools in Finland. While lower secondary school students learn about life and nature, as well as their development and changes in ecosystems in biology, the subject of geography is intended to help students develop a worldview (*National Core Curriculum for Basic Education 2014*, 2016). In general, higher secondary school biology instruction aims to foster a deeper understanding of "the structure, functioning and interrelationships of living nature, as well as the importance of evolution in the development of living things" (Finnish National Agency for Education [OPH], 2023). Earning four credits of biology is compulsory at general upper secondary and obtaining six credits is optional (Finnish National Agency for Education [OPH], 2023b). Geography taught in lukio encourages learners to explore their surroundings, their region, and the world and its changes, and to actively advocate for environmental protection in relation to human activities. For the teaching of geography at the general upper secondary level, two credits are compulsory, and six credits are optional (Finnish National Agency for Education [OPH], 2023b).

In the OECD's Programme for International Student Assessment (PISA), students aged 15 are assessed every three years to determine the degree to which they have acquired the knowledge and skills needed to participate fully in modern-day society (Ikeda & Schwabe, 2019). As part of the assessment, the mathematical and scientific skills of Finnish lower secondary school students are measured. The results show how proficient students are at the end of comprehensive school, but also provide information about the quality of subject teaching. Since the first PISA assessment in 2000, Finnish pupils' performance in mathematics and science has been at a very high level and well above the average compared to the other participating countries and economies (Ikeda & Schwabe, 2019). However, there has been a downward trend in mathematics and science proficiency since 2006. According to the latest PISA 2018 report, student performance in science is significantly below the 2015 results. In mathematics, the decline in performance was evident at all levels, and in science, performance declined especially among the lowest-performing students (Ikeda & Schwabe, 2019). The overall picture of PISA results of the last 20 years suggests that Finnish secondary school students exhibit strong mathematical and scientific skills compared to their peers in other countries. In the long term, however, a persistent decline in the country's mathematics and science standards could also be observed.

2.5.3 Organisation and structure of subject teacher education

"Subject teachers teach specific subjects in the upper grades of basic school (typically grades 7 to 9) and in general upper secondary school [ ]. Subject teachers may be specialized to teach one to three subjects, e.g. mathematics, physics, and chemistry" (Paronen & Lappi, 2018). To qualify as a subject teacher for grades 7 to 12, student teachers must complete teacher education, organised at eight Finnish universities. At university, subject teacher education is provided in cooperation with the faculty for a specific subject, e.g. the Faculty of Natural Sciences, and the Faculty of Education. This cooperation between the faculties ensures that students become experts in their chosen subjects and competent teachers (Niemi & Lavonen, 2020).

For secondary school teachers, the Finnish teacher qualification consists of a Bachelor of Arts (Education) and a Master of Arts (Education) (Jakku-Sihvonen & Niemi, 2006). As illustrated in Table 1, the core elements of teacher education programmes for specialist teachers at the secondary level include pedagogical studies, academic studies in the chosen major subject,

and one or two chosen minor subjects, as well as language and communication and optional studies.

Table 1. Key elements of teacher education for subject teachers.

Adapted from Jakku-Sihvonen & Niemi, 2006, p. 39. ECTS stand for European Credit Transfer System. 1 ECTS equals a workload of 28 hours including contact teaching hours independent and collaborative activities, and examinations.

Secondary school teacher education	Bachelor's degree 180 ECTS	Master's degree 120 ECTS	Total
Subject teacher's pedagogical studies (minor)	25–30 ECTS (including supervised teaching practice) or no ECTS on Bachelor level	30–35 ECTS (including a minimum of 15 ECTS supervised teaching practice or 60 ECTS on Master level	60 ECTS
Academic studies in different disciplines (major)	60 ECTS (including Bachelor Thesis, 6-10 ECTS)	60–90 ECTS (including Master Thesis, 20-40 ECTS)	120-150 ECTS
Academic studies in different disciplines (1-2 minors)	25–60 ECTS	0–30 ECTS	25–90 ECTS
Language and communication studies including ICT, optional studies	35–40 ECTS	0–30 ECTS	35–70 ECTS

The academic studies for secondary school teachers include major and minor subjects in fields of study that are taught at the secondary school level (Jakku-Sihvonen & Niemi, 2006). These academic studies ensure that student teachers are proficient in the research-based knowledge of the subject(s) they teach. The academic studies also include the completion of individual research studies in the form of bachelor's and master's theses.

Pedagogical studies of 60 ECTS are compulsory for all teachers in Finland and consist of at least one-third of practical teaching practices (Niemi & Lavonen, 2020). According to Niemi and Levonen (2020), the aims of pedagogical studies are multifaceted. Firstly, future teachers learn to incorporate subject knowledge, knowledge of teaching and learning, and practice of the school context into their individual pedagogical perspective. Secondly, pedagogical studies support student teachers in recognising the different dimensions of the teaching profession, such as the social, sociological, philosophical, psychological, sociological, and historical dimensions. Furthermore, pedagogical studies provide a framework to reflect on one's role as a teacher and to develop both as a self-reliant expert in the planning,

implementation, and evaluation of teaching and learning and to practice collaborating with other stakeholders in the school environment. Finally, pedagogical studies serve as a basis for lifelong research-oriented learning in the teaching profession (p. 162). To combine theory and practice, pedagogical studies are carried out in cooperation between the university and the teacher training school affiliated with the university (Niemi & Levonen, 2020). At the teacher training schools, the student teachers complete various periods of teaching practicum with the support of supervising teachers. Referring to Niemi and Levonen (2020), the teaching practicum consists of three distinctive phases:

1. Orientation phase: The student teacher makes lesson observations and analyses the learning behaviour of the class.

2. Intermediate phase: The student teacher takes over the planning of the first independent teaching units in a class. In this phase, the students progressively develop their professional work as a teacher.

3. Advanced practicum: The student teacher develops in-depth and extended teaching competence through independent but supervised teaching at a local school or teacher training school.

Although the pedagogical studies are part of the bachelor's or master's degree programme of prospective teachers, it is also possible to undertake the pedagogical studies after completing a subject-specific master's degree programme to exclude dead ends in education (Niemi & Levonen, 2020). This possibility to pursue pedagogical studies and thus become a teacher at a later career stage is relevant as the TALIS survey from 2018 indicates that in Finland, the choice of the teaching profession was not the first choice for around 60% of all teachers surveyed (OECD, 2018).

Studies in communication, languages, and information and computer technology (ICT) are an obligatory part of Finnish teacher education in Finland. In addition, optional studies may include a range of courses that allow students to enhance their degree and skillset (Jakku-Sihvonen & Niemi, 2006).

Despite these elements being universal in the education of secondary school teachers, the structure of studies may vary among different universities (Kansanen, 2003). These organisational differences in the teacher training programme for subject teachers are also reflected in the application and admission procedures at the universities. At some universities,

according to (Paronen & Lappi, 2018), applicants can apply directly to a subject teacher training programme, which comprises a contiguous bachelor's and master's degree programme. Whereas at other universities, students first complete a bachelor's degree in a selected discipline and apply subsequently for a subject teacher specialisation at the master's level. Depending on the university, admission to subject teacher training is granted on the basis of aptitude tests including an interview, or on the basis of the applicant's academic performance and the result of an aptitude test (Paronen & Lappi, 2018; Pollari et al., 2018). A third path toward the subject teacher profession entails completing separate pedagogical studies after an academic degree (Paronen & Lappi, 2018).

Even though the traditional distinction between class and subject teacher education is maintained at many universities, "the structures of the respective degree [programmes] allow students flexible routes to include both in the same [programme] or to permit a later qualification in either direction" (Niemi & Lavonen, 2020, p. 160). In addition, some universities have initiated a hybrid teacher training programme that prepares students for both classroom teaching and subject teaching, especially in the science subjects (Finnish National Agency for Education [OPH], 2023a).

A particular role in the teacher training of mathematics and science teachers is played by the LUMA centre (Niemi, 2015). LUMA is a shortening of the Finnish words for science (fi. luonnontieteet) and mathematics (fi. matematiikka). The first LUMA centre was opened at the University of Helsinki in 2003 and today comprises a network of regional LUMA centres at 13 Finnish universities whose activities include supporting student teachers and teachers in the disciplines of science, technology, and mathematics (STEM) (LUMA Centre Finland, 2022; Vihma & Aksela, 2014). Referring to Niemi (2015), LUMA centres provide space and opportunity for student teachers to explore and gain experience in teaching and subject-related interaction with children and adolescents. "Pre-service teachers also use the latest research information to actively produce teaching materials and ideas that benefit all teachers of STEM subjects in Finland" (p. 289). These first authentic teaching experiences form the basis for the lifelong learning of mathematics and science teachers which is supported at the LUMA centre by in-service education (Vihma & Aksela, 2014).

2.5.4 Popularity and demand of mathematics and science subject teachers

Titles of academic literature such as "In Teachers We Trust - The Finnish Way to Teach and Learn" (Pollari et al., 2018) and "The most wanted: Teachers and teacher education in

Finland" (Sahlberg, 2013) suggest that teaching is generally a popular and respected profession in Finland. Indeed, the 2018 *Teaching and Learning International Survey* (TALIS) confirms that almost 60% of teachers in Finland agree with the statement that the teaching profession is valued in society, which is higher than the average of teachers in other education systems surveyed. Moreover, the OECD report indicates that the share of teachers who state that the teaching profession is respected in Finnish society has remained stable compared to the previous survey in 2013 (OECD, 2018).

In the 2013 TALIS survey, the majority of Finnish teachers surveyed (95%) stated that they were satisfied with their profession and that as many as 85% of respondents would choose the teaching profession again (OECD, 2013). In the more recent 2018 TALIS survey, the reported job satisfaction of Finnish teachers decreased by three percent, also fewer teachers said they would choose the teaching profession again (OECD, 2018). A dramatic change in teachers' job satisfaction emerged during the COVID-19 pandemic. A study conducted by the Finnish teacher union OAJ 2021, which also surveyed a large proportion of secondary school teachers, showed that more than half of the participating teachers were considering changing jobs. Reasons for considering changing jobs, according to the study, were the COVID-19-pandemic-related elevated burden of work, increased workload, and low salary levels (OAJ, 2021). The latest development in job satisfaction among Finnish teachers, especially among secondary school teachers since this survey, is not known. Nevertheless, a public discussion on the decreased job satisfaction of teachers may impact on the future popularity of the teaching profession.

For long, the teaching profession has been a popular career choice amongst Finnish students. While study programmes leading to a teaching profession are popular among applicants, only a small proportion is selected for the studies and can pursue their career aspiration of becoming a teacher (Pollari et al., 2018; Sahlberg, 2013). Niemi and Lavonen (2020) attribute the popularity of the teaching profession to revisions in the education system, increased societal esteem and trust in the teaching profession as well as a high level of professional autonomy. Nevertheless, teacher training programmes show differences in popularity based on subject specialisation, as highlighted by Pollari and colleagues (2018). They note that subject teachers are usually chosen from highly skilled and motivated students, with subject choice playing a role to some extent. However, the lack of consistent procedures across universities makes it difficult to obtain accurate data on the number of applicants and admissions to subject teacher training programmes (Pollari et al., 2018). Additionally, annual

and subject-specific variations can be assumed in the number of candidates applying to teacher education and entering the teaching profession (Pollari et al., 2018). Notwithstanding, teacher statistics suggest that the demand for subject teachers is largely met. For instance, a report *Teacher Prequalification 2025* was presented by the Institute for Educational Research in 2018, based on data from 2016. This report suggests that enough qualified subject teachers will be working in schools until 2025 (Kannisto, 2018, as cited in Moilanen & Neittaanmäki, 2021). In relation to mathematics and science subject teaching, however, a more worrisome picture emerges. Although it could be assumed on the basis of data from 2016 that there will be enough qualified teachers in the future to cover the demand for specialist teachers for mathematics and science subjects until 2025, a significant decline in student teachers of mathematics and science subjects could already be identified in this report (Moilanen & Neittaanmäki, 2021).

In 2021, Moilanen and Neittaanmäki published a study that specifically investigated the number of graduates in subject teacher education for mathematics, physics, and chemistry at different Finnish universities. The results of the study are summarised in Figure 4.
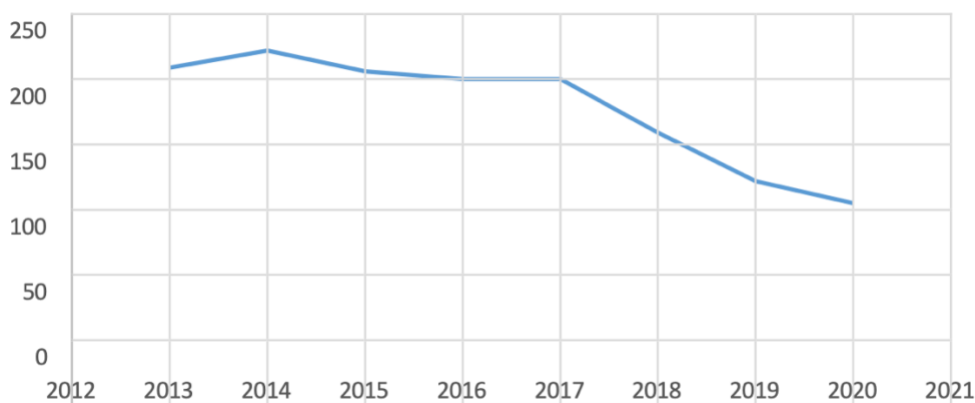
Figure 4. Number of teacher student in subject teacher education for mathematics, physics, and chemistry between 2013 and 2020 in Finland (excluding University of Joensuu).

The vertical axis shows the number of subject teaching students, the horizontal axis represents the years (Moilanen & Neittaanmäki, 2021, p. 11) (licensed under CC0 1.0.).

As the graph in Figure 4 shows, there was a slight decrease in subject student teachers for mathematics, physics, and chemistry between 2014 and 2017. Between 2017 and 2020 a plunge in teacher students for these subjects occurred. Referring to Moilanen and Neittaanmäki (2021), this "downward trend [ ] is worrying [as] the number of teacher trainees has decreased from 250 to 155, meaning that the percentage of trainees has decreased by 38% over [a three year] period" (p. 11).

This drop in the number of subject teacher students is particularly concerning as previous research, such as that by Nissinen and Välijärvi (2011), suggests that only 85% of those who hold a teaching qualification actually work as subject teachers in comprehensive and general upper secondary education. However, as no real-time statistics are available to determine the proportion of graduates who enter teaching positions after graduation, the current rate may be even lower (Moilanen & Neittaanmäki, 2021). Based on the number of student teachers, it is already foreseeable that, despite declining birth rates and thus lower demand for teachers, the future demand for mathematics, physics, and chemistry at the secondary level cannot be met (p. 5). In addition, it is yet uncertain how much the impact of the COVID-19 pandemic will affect future applications for teacher education and entry into the profession of mathematics and science teachers. Nevertheless, Moilanen and Neittaanmäki suggested already in 2021 to explore the root causes for the sharp decline in the number of student teachers in mathematics, physics, and chemistry, as a lack of highly qualified teachers can lead to lower scientific competence of future generations in Finland and to economic disadvantages.

2.5.5 Previous research on Finnish student teachers' motivation for teaching

As described earlier in this chapter, examining student teachers' motivation for teaching is one way to understand teacher shortage. Therefore, this section reviews previous research on initial motivation for teaching and motivational changes during teacher education in the Finnish context.

Initial motivation for teaching

Recently, Finnish teacher students' motivation for teaching was examined through the use of the FIT-Choice scale in three international comparative studies (Giersch et al., 2021; Goller et al., 2019; Taimalu et al., 2021). While Giersch et al. (2021) and Taimula et al. (2021) only reported comparative results with other countries, Goller and colleagues (2019) provided both specific analyses for the Finnish sample and comparisons with a German sample.

In their study, Goller and colleagues successfully replicated the FIT-Choice scale in the Finnish context with minor modifications in 2019. In addition, they analysed student teachers from different programmes, namely preschool teachers, primary school teachers, and subject teachers separately. When examining subject student teachers' motivations from the Finnish sample, the intrinsic value, prior teaching and learning experiences and perceived teaching ability were found to be the most important motivations for teaching (Goller et al., 2019).

Teaching as a fallback career was the smallest rated factor for the choice of the teaching profession. Finnish subject student teachers perceived the task demand of the teaching profession as higher than the task return. Hence, Finnish student teachers acknowledge that teaching is highly demanding and requires expert knowledge (Goller et al., 2019).

Motivational developments

Already in 2008, Malmberg published an investigation of longitudinal study data of a sample of Finnish-Swedish student teachers, from the beginning of their studies to graduation, for changes and stability in the goal orientation of student teachers. Although this study was based on goal orientation theory, it suggested that mastery goal orientation, which is linked to intrinsic motivation for teaching, increases in the course of teacher education. Interestingly, mastery goals, but also performance goals as well as performance-avoidance goals were most pronounced during the practical training period (Malmberg, 2008). The results of this study indicate that there are changes in motivation for teaching during teacher education. This motivation appears to peak during the practical teaching phases of teacher education, where students gain their first experiences in t in the role of teacher and the professional working context of school.

In a mixed-method study, Virtanen and Laine (2021) compared Finnish novice teachers and student teachers for primary schools who want to work as teachers with those who do not. Moreover, they studied the reasons for anticipated career changes. The researchers could identify job-related reasons, person-related reasons, and unrealistic ideas about the profession as the main reasons for a possible career change in student teachers and novice teachers. The most common reason given for considering not completing a teaching degree or changing careers was an unrealistic idea of the teaching profession. This result can be understood as a *practice shock* for student teachers and novice teachers. According to Rots et al. (2012), this practice shock may have led to a conflict with the participants' pre-formed personal interpretative frameworks and thus resulted in a reduced motivation for teaching.

2.6 Research objectives and questions

In the previous sections of this master's thesis, an emerging shortage of mathematics and science subject teachers in Finland has been identified, based on the current number of student teachers. As previous research has indicated, one way to approach teacher shortage is to investigate the motivations of prospective teachers for the teaching profession. However, to

the best of the author's knowledge, no studies have yet specifically explored initial motivation and motivational development among subject (teacher) students of mathematics and science in Finland. Thus, the research objectives of this thesis are to generate an understanding of why Finnish students of mathematics and science choose to pursue teacher education and later enter the teaching profession.

As the first study to investigate the motivational influences on the career choices of mathematics and science (teacher) students in Finland, this thesis aims to shed light on motivational influences before and during academic and pedagogical training. Therefore, the first research question is:

RQ1. What are the initial motivations of Finnish mathematics and science students for pursuing teacher education?

The following hypotheses can be formed based on the findings of Goller et al. (2019) and exploratively:

1.1 On average, mathematics and science students rate intrinsic value, prior teaching and learning experiences, and perceived teaching ability as the most essential factors for choosing a career in teaching, compared to other motivational factors.

1.2 Motivation for teaching differs in relation to student's intention to pursue teacher education.

1.3 On average, mathematics and science students perceive the teaching profession of higher task demand and lower task return.

1.4 Perception of teaching differs in relation to student's intention to pursue teacher education.

These hypotheses draw on the structure of the studies to become a subject teacher at some Finnish universities, where a subject-based bachelor's degree is followed by the possibility to specialise as a subject teacher in the master's degree programme.

Regarding professional development, previous international and Finnish studies indicate that motivation to become a teacher may sustain or change during teacher education. Hence, another aim of this thesis is to investigate how the motivation of subject teachers of

mathematics and science studies evolves during their academic and pedagogical training. Thus, the second research question is formulated as followed:

RQ2: How is the career motivation of Finnish student teachers of mathematics and science subjects affected by their experiences during academic and pedagogical education?

Particularly, in connection with the first research question and the findings of Rots et al. (2012), the aim is to explore in the Finnish context:

2.1 Which factors influencing the initial career choice in teaching do student teachers of the mathematics and science subjects report at the end of their studies?

2.2 Does the initial motivation of student teachers of the mathematics and science subjects shift during their academic and pedagogical studies?

2.3 Do critical individuals, incidents, or phases during teacher education contribute to the motivational sustainment or change in student teachers of mathematics and science subjects?

Finding answers to the defined research questions can provide a comprehensive understanding of mathematics and science students' motivation for the teaching profession. By examining the factors that influence the choice of the teaching profession and the development of motivation during teacher education, this research can provide useful recommendations for individual decision-making, as well as organisation and support in education at the university level. Ultimately, this may help address and prevent the shortage of qualified teachers in these critical subject areas of mathematics and science.

3 Methodology

In this chapter, the methods used to study the above-mentioned research questions are described.

3.1 Research Design

The chosen research design for addressing the research questions involves a combination of both quantitative and qualitative research methods. This mixed-methods approach was deemed appropriate as it allows for the study of the theoretical concept of motivation for a teaching career, which comprises two stages - initial and sustaining motivation. Correspondingly, this type of research "enables a more comprehensive and complete understanding of phenomena to be obtained than single methods approaches" (Cohen et al., 2018, p. 33).

Regarding the initial motivation for choosing teaching as a career, in previous research motivational variables were identified based on the FIT-Choice model, and factors influencing the career choice for teaching were quantified as illustrated in the theory chapter of this thesis (Watt & Richardson, 2007). This quantitative approach to investigating initial career choice motivation for the teaching profession was adopted in the context of this thesis. Accordingly, the first overarching research question was addressed with the help of quantitative research methods.

However, following Kelchtermans' (1993) understanding of professional development during teacher education, consisting of personal experiences with the professional environment and the individual view of the teaching profession and oneself as a teacher. The motivational development of student teachers is accordingly considered "subjective, interactionist and constructed" and can best be investigated with qualitative research methods (Cohen et al. 2018, p. 175).

For a holistic understanding of the initial motivation for teaching and the motivational development in relation to the teaching profession during the academic and pedagogical training of mathematics and science students, a longitudinal study design following either the same students or a specific group in their university education would be beneficial. However, such a long-term study design is not feasible within the framework of a master's thesis. Nevertheless, to obtain a possibly holistic view within a *cross-sectional* study design, this study focuses on two points in time during the university education of student teachers. These

time points represent the beginning of the bachelor's degree in mathematics and science and the specialisation as subject teachers during or after the pedagogical studies. Hence, quantitative, and qualitative research methods were applied with reference to two points in time in university education. Accordingly, this research is composed of two research approaches which were collected in two research phases. For a better overview of the methodological approach in this thesis, the remainder of this chapter is divided into quantitative and qualitative methods subsections.

The quantitative data were collected in the research context of a joint project of three Finnish universities. The following quantitative method section provides a description of the research context, as well as information about the sample and the research instruments that are relevant to this thesis. Furthermore, quantitative data analysis will be described. Thereafter, the qualitative method section presents the data collection procedure including an explanation of the semi-structured interviews, commentary on the acquisition and description of the sample, as well as the structure of the data analysis. To provide an overall view of the methodological procedure in this thesis, Table 2 depicts the schedule of the collection of quantitative as well as qualitative data.

Table 2. Overview of the chronological sequence of measurements with defined population and relevant constructs.

Measuring time 1	Measuring time 2
September to December 2021	March 2022
First-year mathematics and science students	Student teachers for mathematics and science subjects
Quantitative measurement of initial teaching motivation of first year students of mathematics and sciences subjects	Qualitative measurement of changes in the career choice motivation of teacher students of mathematics and science subjects

3.2 Quantitative Methods

3.2.1 Sample and data collection

Quantitative data used in this master's thesis originates from the cross-university project KOPTUKE (fi. Kuinka eri opettajankoulutusohjelmat tukevat tulevia luonnontieteiden opettajia käyttämään tukivan oppimisen menetelmiä opetuksessaan?, engl. How do different teacher education programmes support future science teachers in using inquiry-based learning methods in their teaching?).

Data used in this thesis was collected exclusively from the faculty of mathematics and natural science in one of the participating universities. First-year students of mathematics and sciences subjects were recruited with the help of the study coordinators and university teachers of the respective subjects. A total of 52 students responded to an online questionnaire. The necessary condition for voluntary study participation was student consent for the collection, analysis, and retention of the data. After data cleaning, which became necessary due to missing data for relevant items, the collected data from 50 students was included in further analysis.

As summarised in Figure 5, participating university students (N=50) studied biology, physics, chemistry, geography, mathematics, information technology (IT), and statistics as their major subjects. The majority of the participants were mathematics students (30%), closely followed by chemistry students (26%).
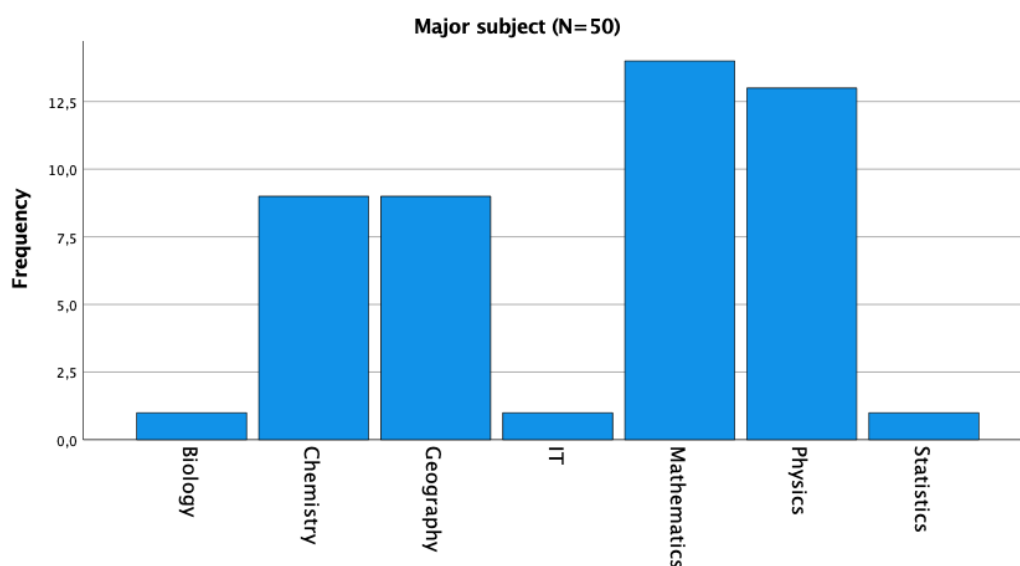
Figure 5. Bar chart of the distribution of study participants by major subject.

The data was collected in autumn 2021 in one of the participating universities using the online tool *Webropol*. The survey was conducted in the Finnish language. The questionnaire used can be found in Appendix 1. To ensure anonymity, no personal data was collected. The study data were controlled and securely shared with the university online disk service *seafile*.

3.2.2 Instrumentation

Quantitative data was collected using an online survey. This online survey comprised the collection of study information, such as the degree programme and the subjects studied, as well as the measurement of several constructs, including teacher efficacy and initial

motivation for teaching. For this study, the measurement of the *intention to pursue teacher education,* as well as motivations for teaching and perceptions of the teaching profession are relevant to answer the first research question of this thesis.

Intention to pursue teacher education was measured by the following item whether the study subjects could imagine becoming a subject teacher: Oletko ajatellut hakevasi aineenopettajan opintoihin opintojesi aikana? [engl. Have you thought about applying to become a subject teacher during your studies?]. Responses were measured on a 4-point Likert scale (1= yes; 2= maybe; 3= no; 4= I don't know). The measurement of intention for teaching education is relevant because to qualify as a subject teacher in mathematics and science at the participating university, as at other Finnish universities, there are various study paths and subject combinations that lead to the teaching profession. However, the main course of study to become a subject teacher is structured in such a way that students enrol for a science bachelor's degree (luonnontieteiden kandidaatti - 3 years) and the philosophy master's degree (filosofian maisteri - 2 years) in their major subject. The bachelor's degree programme commonly comprises basic studies in the major subject and the completion of one or two minor subjects. In the third bachelor's year, students decide on the specialisation in the master's programme, and in this context can opt for the subject teaching degree studies. The subject teaching degree studies mostly comprise teacher training in the first year of the master's degree, i.e. the pedagogical studies as well as advanced studies and the master's thesis is written in the second year of study. In accordance with the study structure, the subject students had not yet decided on a specialisation as subject teachers at the time of the survey. However, it is reasonable to suspect that amongst the group of first-year students of mathematics and science subjects are individuals who have already or not yet decided on their academic and professional careers. It can be assumed that the intention to undergo teacher education impacts the motivational factors for the teaching profession.

Motivations for and perceptions of teaching were assessed in the form of a self-report using the FIT-Choice scale, which was developed by Watts and Richardson in 2007 and translated into Finnish by Goller et al. (2019). The FIT-Choice scale is a valid and reliable instrument to measure the career-specific motivation and beliefs relevant to choosing teaching as a career of teacher students, who have already decided to become teachers (Watt & Richardson, 2007, Goller et al., 2019). However, the target population examined using quantitative methods in this study are first-year subject students of mathematics and science who have not yet decided to enrol in teacher training and become teachers. As a result, the sample analysed in this thesis

differs significantly from the population for which the FIT-Choice scale is intended. For a better fit with the surveyed sample, items were revised by the KOPTUKE project team, the overall framing was changed, item formulations were adapted, and unsuitable items were omitted. A total of 16 scales consisting of 49 items of the following dimensions are assessed: motivations for teaching (11 scales) and perceptions about teaching (5 scales). A scale measuring satisfaction with career choice was omitted, as the study subjects had not yet decided to pursue a teaching degree. Moreover, in this thesis, *social dissuasion* was investigated using only two survey items, as the formulation of a third item did not follow the concept's definition. All items are measured on a 7-point Likert scale. In the scale of *motivation for teaching*, the items were preceded by the following statement: "Imagine yourself in a situation where you want to apply for teacher training. To what extent would the factors listed below influence your decision to apply to become a teacher? Choose the option that best describes you on a scale of 1 to 7?" (1 = insignificant, 7 = extremely important). The instructions for the scale *perceptions of teaching* were "Please assess the extent to which the following questions would apply to you. Choose the best option on a scale of 1 to 7" (1 = not at all, 7 = to a large extent).

3.2.3 Statistical data analysis

Statistical data analysis was performed using Statistical Package for the Social Science (SPSS, version 27.0) and Jeffreys's Amazing Statistics Program (JASP, version 0.16.3).

3.2.4 Evaluation of quality criteria in quantitative research

In assessing the quality of a quantitative study, the essential principles for evaluating the trustworthiness of the research are *reliability* and *validity*. Since the FIT-Choice scale in this study is applied to a different population than the one for which it was developed and validated, it is essential to investigate whether it measures motivation for and perceptions of teaching.

Reliability
According to Fraenkel and Wallen (2009), the reliability of an instrument indicates how consistent measured results remain across measurements. A method commonly used to assess the reliability of an instrument is the internal-consistency method, which compares item scores against another subset of items of the same scale (Fraenkel & Wallen, 2009). Fraenkel and Wallen (2009) argue that the advantage of this method of estimating reliability is that it requires only a single application of the instrument. For this reason, this method is also the

most appropriate for this study. More precisely, *alpha coefficients* were calculated for the items of the two subscales of the FIT-Choice scale. In a previous study in the Finnish context by Goller et al. (2019), acceptable to good reliability values were obtained. Therefore, reliability values of *Cronbach's alpha* (α) above .60 or better than .70 were also expected for this study (Cohen et al., 2018).

Table 3. Subscale motivation for teaching.

Overview of factors of motivation for teaching subscale, item numbers, example items and reliability estimation using internal consistency method (Cronbach's α).

Factor	Item numbers	Example Item	Cronbach's α
Motivation for Teaching			.82
Perceived Teaching Ability	BFIT 3,14, 29	I have the qualities of a good teacher.	.93
Intrinsic Value	BFIT 1, 6,9	I am interested in teaching.	.83
Personal Utility Value			.63
Job Security	BFIT 11,19, 26	Teaching will be a secure job.	.86
Time for Family	BFIT 3, 12, 20	Teacher's working hours will fit with the responsibilities of having a family.	.70
Social Utility Value			.81
Shape Future of Children/ Adolescents	BFIT 7, 16, 32	Teaching will allow me to shape child/adolescent values.	.94
Enhance Social Equity	BFIT 24, 31, 33	Teaching will allow me to benefit the socially disadvantaged.	.90
Make Social Contribution	BFIT 5, 15, 22	Teaching enables me to give back to society.	.69
Work with Children/ Adolescents	BFIT 10, 18, 34	I want a job that involves working with children and adolescents.	.91
Fallback Career	BFIT 8, 23, 30	I was unsure of what career I wanted.	-
Prior Teaching and Learning Experiences	BFIT 13, 21, 27	I have had inspirational teachers.	.84
Social Influences	BFIT 2, 17, 28	My friends think I should become a teacher.	.89

Note. Factors in italic are first-order constructs. Item numbers originate from KOPTUKE mapping (Veermans, 2021).

Table 3 contains information on the structure of the FIT-Choice subscale *motivation for teaching*, item numbers, example items of the subscales as well as information on the reliability estimation measure of the internal consistency of the subscale as measured in Cronbach's α. In this study, the overall internal consistency of the subscale *motivation for*

teaching yields a Cronbach's α coefficient of .82, which is highly reliable (Cohen et al., 2018). Furthermore, Cronbach's α for the factors of the scale *motivation for teaching* ranged between .63 and .94 and hence, indicate an acceptable to good reliability of the scale. The only exception marks the variable *fallback career*, which indicated a negative Cronbach's α. However, Cronbach's α is only defined from 0 to 1 and should therefore not exhibit negative values (Streiner, 2003). Reverse item coding, which is often the reason for a negative correlation and thus leads to negative internal consistency, is not given in the items of the scale. However, Watt et al. (2012) reported inadequate reliability of the *fallback career* factor in international samples prompting the omission of this subscale in the context of an international validation study. Due to the inadequate reliability in this study, the factor is excluded from further analyses.

Table 4. Subscale perception of teaching.

Overview of factors of perception of teaching subscale, item numbers, example items and reliability estimation using internal consistency method (Cronbach's α).

Factor	Item numbers	Example Item	Cronbach's α
Perceptions of Teaching			.29
Task Demand			.60
High Demand	BFIT 35, 36, 37	Do you think teachers have a heavy workload?	.78
Expert Career	BFIT 38, 39, 40	Do you think teaching requires high levels of expert knowledge	.71
Task Return			.60
Social Status	BFIT 41, 42, 43	Do you believe teaching is perceived as a high-status occupation?	.82
Salary	BFIT 44, 45, 46	Do you think teaching is well paid?	.90
Social Dissuasion	BFIT 48, 49	Did others tell you teaching was not a good career choice?	.39

Note. Factors in italic are first-order constructs. Item numbers originate from KOPTUKE mapping (Veermans, 2021).

Internal consistency for the scale *perceptions of teaching* and its factors were calculated using the coefficient for inter-item correlations Cronbach's α. Scale information, such as item numbers, example items, and estimations of Cronbach's α can be found in Table 4. Whilst Cronbach's α for the overall scale *perceptions of teaching* is low (Cronbach's α = .29), the subscales range from .39 and .90, indicating low to high reliability of the subscales (Cohen et

al., 2018). While the motivation subscale in this study is reliable except for the factor *fallback career* based on internal consistency, reliability problems occur in the *perceptions of teaching* subscale. Possible causes and effects of the reliability problem are addressed in more detail in the discussion section of this thesis.

Validity

Validity is defined "as referring to the appropriateness, correctness, meaningfulness, and usefulness of the specific inferences researchers make based on the data they collect" (Fraenkel & Wallen, 2009, p. 148). Concerning the validity of an instrument, the instrument should measure what it claims to measure (Fraenkel & Wallen, 2009).

Content validity of the FIT-Choice scale is assumed by the theoretical FIT-Choice model according to Watt and Richardson (2007). Face validity, which indicates whether an instrument appears at first glance to be relevant and appropriate to what it measures (Bhandari, 2022a). Goller et al. (2019) found evidence of face validity in their study for the FIT-Choice scale. In this study, the researchers of the KOPTUKE project assessed face validity for measurement as appropriate after adjusting the scale.

Construct validity is concerned with how well an instrument measures the concept it was designed to assess (Bhandari, 2022b). Construct validity of the Finnish FIT-Choice scale was assessed by Goller et al. (2019) using *confirmatory factor analysis* (CFA). These CFAs revealed that some items, e.g. items measuring intrinsic value, were problematic. After further estimation of CFAs without the problematic items, an acceptable-to-good model fit was indicated. In this study, *exploratory factor analysis* (EFA) was conducted to assess construct validity using JASP. It was decided to conduct an EFA, despite having a too small sample size (*N*=50) because the population to be investigated in this study and the research questions differed greatly from previous applications of the FIT-Choice scale. According to MacCallum et al. (1999), a sample size of *n* = 60 should be fulfilled for an EFA to be performed (Klopp, 2010). The scale *fallback career* was not included in this EFA due to its problematic reliability. As a necessary prerequisite, the EFA was preceded by a Bartlett test to check for sphericity (Field, 2013). The result of Bartlett's test is significant (χ^2 350) = 105, *p* < .001), and thus the data are suitable for conducting a factor analysis. Furthermore, the suitability of the data for an EFA was assessed using the *Kaiser-Meyer-Olkin measure* (*KMO*) and the *Measure of Sampling Adequacy* (*MSA*) (Bühner, 2011; Klopp, 2010). According to the recommendation of the literature, the data of the scale showed poor to good suitability

($KMO = .64$; $.33 \geq MSA \geq .91$) for factor analytic procedures (Klopp, 2010). Despite the too-small sample and the insufficient KMO values, the EFA was carried out to provide relevant evidence on factor loading in the research setting, which is very different from the original research framework. Table 5 shows the factor loadings of the individual FIT-Choice sub-scales.

Table 5. Factor loadings of an exploratory factor analysis.

Label	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Uniqueness
Intrinsic Value	0.98						0.14
Perceived Teaching Ability	0.92						0.09
SUV Work with Children	0.74						0.20
SUV Shape Future		0.89					0.08
SUV Enhance Social Equity		0.77					0.24
SUV Make Social Contributions		0.65					0.52
Prior Teaching Learning Experience		0.46					0.60
TD Expert Career			0.76				0.41
TD High Demand			0.66				0.37
TR Social Status				0.80			0.19
TR Salary				0.58			0.65
PUV Job Security					0.83		0.25
PUV Time for Family					0.52		0.67
Social Dissuasion						0.75	0.41
Social Influences						0.69	0.43

Note. Applied rotation method is promax.

As shown in Table 5, EFA results suggested that the data of this study does not map to the theoretical structure of the FIT-Choice model. Variables underlined in Table 5 that do not belong together in the theoretical model load on common factors based on the data. Although

these EFA estimates can only be considered with caution, due to the absence of essential preconditions, the results are regarded as an indication of insufficient construct validity in this study. Potential causes and consequences of insufficient construct validity are discussed in the discussion section of this thesis.

3.3 Qualitative methods

3.3.1 Sample and data collection

As a condition of participation in the semi-structured interviews, student teachers were required to study mathematics or a science subject as their major or minor studies and be either currently enrolled in or have completed practical teacher education, i.e., pedagogical studies. From this group, both students who are sure that they want to become science teachers and students who are not sure whether they will follow this path were targeted. In March 2022, all mathematics and science student teachers enrolled in the pedagogical studies at the participating university in the academic years 2020 to 2021 and 2021 to 2022 were recruited via email with the help of the responsible study coordinator. The invitation for the interviews can be found in Appendix 2. Before interviews took place the interview guide was piloted, and privacy notices were provided for the interview participants via email (for privacy notice see Appendix 3). Consent to the privacy notices was given verbally on record at the beginning of each interview. In total, seven student teachers voluntarily participated in the interviews. A detailed description of this sample (N=7) containing information about the studied subjects, as well as the status and timing of the teacher training can be found in Table 6. To ensure the anonymity of the interview participants, no further demographic information was collected.

All interviews were conducted in English either in-person or virtually via Zoom and recorded. The English language was deemed appropriate as the medium for the interviews, as the students use the English language in some subjects at the university. However, to ensure the absence of language difficulties, the interview participants were asked at the end of the interviews if any answering difficulties arose due to the use of the English language. All participants stated that answering the questions in English was not a problem. The interviews lasted on average 40 minutes. Similarly, to the handling of the questionnaire data, the interview data were pseudonymised, and all identifying information of the study subjects was erased. The storage of the interview data followed the terms of the agreed privacy notice.

Table 6. Sample description of semi-structured interviews.

Label	Major subject	Scientific minor subjects	Completion of teacher training at the time of the interview	Teacher training completed during (1) or after subject studies (2)
S1	mathematics	physics, chemistry information technology	completed	1
S2	mathematics	physics	ongoing	1
S3	chemistry	physics, mathematics, special education	completed	1
S4	mathematics	physics	ongoing	1
S5	physics	mathematics, chemistry, computer sciences	completed	1
S6	physics	mathematics, chemistry	completed	1
S7	physics	mathematics	completed	1

Note. S as abbreviation for student teacher.

3.3.2 Instrumentation

Semi-structured interviews aimed on the one hand to substantiate the results of the first quantitative stage. On the other hand, motivational changes for teaching during academic and pedagogical training were explored. Therefore, an interview guide from Rots et al. (2012) was used as the basis for the interviews. Questions of the interview guide were adapted to the Finnish education context and piloted beforehand. The interviews contained nine predefined categories. The categories included questions about background information on the student teacher's course of study; motivational changes during academic and pedagogical training; reasons and motives for the teaching career; critical events, persons, and phases; and facets of teacher self-understanding according to Kelchtermans (1993). Furthermore, student teachers' suggestions for future improvements in the teacher education and profession and advice for students, who are uncertain about their career choice were asked. An overview of all interview questions can be found in Appendix 4.

3.3.3 Qualitative content analysis

As an analysis method for the interview data, qualitative content analysis was chosen. In preparation for qualitative content analysis, interviews were transcribed. Thereafter, to ensure the accuracy of the transcripts, they were sent again to the interview subjects for proofreading. Proofread transcripts of the interviews were imported to NVivo 12, which is a qualitative

research software developed by QSR International (2022). For the creation of the coding scheme, a deductive approach was applied. The deductive content analysis is used for analysis aiming to investigate existing concepts, hypotheses, theories, or models in a new context (Elo & Kyngäs, 2008). To find categories in this study, a deductive analysis approach is appropriate because the goal of the interviews was to explore existing theory and empirical findings of change in job motivation based on teacher education experiences theorised by Kelchtermans (1993) and Rots et al. (2012) in the Finnish context among mathematics and science student teachers. In this analysis, an unconstraint matrix was developed, which means that "different categories are created within its bounds, following the principles of inductive content analysis" (Elo & Kyngäs, 2008, p. 111). Moreover, student teachers' motivational development was analysed case by case. The coding scheme was piloted beforehand with a smaller proportion of the data. During the initial coding phase containing all data three major categories were defined, namely *Factors for choosing teaching as a career*, *motivational development*, and *Persons, incidents, or phases with critical impact*.

In five coding rounds, in which the data were analysed for one category at a time, several subcategories could be defined for each category in an inductive manner. Item accuracy pertains to sentences and paragraphs of the transcribed interview data.

After the initial coding, the data was partially double-coded. For the double coding phase, an intercoder was introduced to the initial coding scheme and two interviews were randomly selected, containing ca. 25% of the analysed data. Interrater reliability was 92%. Differences in coding were resolved through discussion and recoding of singular items. The final coding scheme is attached to this thesis in Appendix 5.

3.3.4 Evaluation of quality criteria in qualitative research

In order to critically reflect on the quality of the applied qualitative research methods, "*dependability, credibility, transferability,* and *confirmability* as trustworthiness criteria [are considered]" according to Anney (2014, p. 2). In addition, the criterion of *authenticity* will be assessed.

Credibility refers to the trust in the truthfulness of the research results, i.e. the degree to which findings are credible and measurable (Anney, 2014). To ensure the credibility of the research findings, the results can be traced back to the transcribed interviews. In addition, all analysis

steps are reported, and the coding scheme is provided in Appendix 5 with corresponding code definitions and coded example items to allow traceability of results.

Dependability refers to the absence of dependence of research results on data collectors, evaluators, or other parties. To ensure the quality criterion of dependability, ca. 25% of the data were analysed by an independent coder. This double coding resulted in an agreement of 92%. Furthermore, the research was not funded by any third party and no conflicts of interest arise.

According to Baxter and Eyles (1997), *confirmability* refers to the extent to which research findings can be confirmed but not changed by other researchers. The double coding performed as well as subsequent discussions, which on the one hand strengthened the coding scheme and on the other hand led to slight adaptations of the coding scheme, are intended to ensure confirmability.

Transferability, according to Bitsch (2005), refers to the extent to which qualitative research findings are transferable to other research contexts or conditions. The research findings can be regarded as transferable as the collection of data is based on previous research by Rots et al. (2012). Furthermore, all phases of the data analysis were described with the necessary specificity to enable replicability. As the quality criterion of transferability is also equated with generalisability in the literature (Anney, 2014), it should be emphasised that the aim of this research was exploratory, and no claim is made to generalisability. Generalisability cannot be guaranteed due to the small sample with a focus on only one teacher education institution in Finland.

Authenticity is understood as the accuracy of the research data (James & Busher, 2006). The authenticity of the research data can be considered assured because the results are based on real interview data that have been proofread by the study participants. Moreover, results can be compared with previous research (see Rots et al. 2012). Quotations from the interview transcripts are provided to support the research findings.

4   Findings

This chapter contains the results of the analyses carried out. To ensure a clear overview of the results, this chapter is divided into a quantitative and a qualitative results section.

4.1   Quantitative findings

Quantitative research methods were used to identify the initial motivations of Finnish mathematics and science students for entering teacher education. For this purpose, the defined hypotheses in section 2.6 are tested.

4.1.1   Intention to pursue teacher education

As described in the methods section, the intention of beginning students of mathematics and science subjects was assessed with the help of the item *Oletko ajatellut hakevasi aineenopettajan opintoihin opintojesi aikana?* [Have you thought about applying to become a subject teacher during your studies]. Examining the distribution of the study participants according to their affinity for teacher education as displayed in Figure 6, a large majority of respondents stated that they had not considered applying to teacher education (58%). In contrast, 20% of participants responded that they maybe consider applying to the teacher training whilst 18% stated that they had considered applying to the pedagogical studies offered at their university. Only 4% stated they did not know whether they consider applying for teacher education.
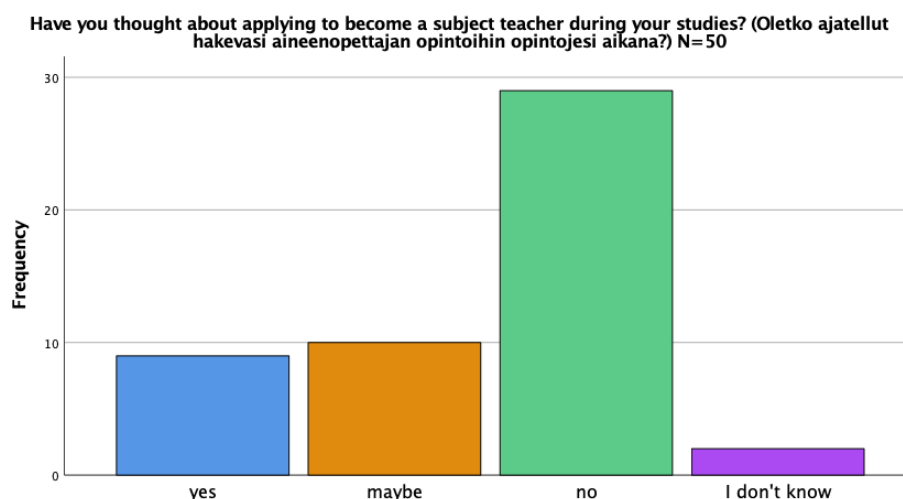

Figure 6. Bar chart of the distribution of participants by intention to pursue teacher education.

Table 7 shows the responses to the item "Have you thought about applying to be a subject teacher during your studies?" by major subject. It illustrates that surveyed students of

mathematics (*n=6*), chemistry (*n=2*), and geography (*n=1*) stated that they had considered becoming a subject teacher. In contrast, surveyed students of biology (*n=1*) and mathematics (*n=4*), as well as a large proportion of students of chemistry (*n=6*), geography (*n=7*), physics (*n=10*), and statistics (*n=1*) stated that they had not considered applying to study in the subject teacher training. All other respondents (*n=10*) indicated that they might have considered applying for the subject teacher programme. Only two participants reported that they did not know whether they had considered applying to teacher education.

Table 7. Crosstabulation.

Student's major subject and their responses to the item Have you thought about applying to become a subject teacher during your studies? (Oletko ajatellut hakevasi aineenopettajan opintoihin opintojesi aikana?).

Major Subject	Intention to apply for teacher education: „yes"	Intention to apply for teacher education: „maybe"	Intention to apply for teacher education: „no"	Intention to apply for teacher education: "I don't know"	Total
Biology	0	0	1	0	1
Chemistry	2	1	6	0	9
Geography	1	1	7	1	10
Information technology	0	1	0	0	1
Mathematics	6	4	4	1	15
Physics	0	3	10	0	13
Statistics	0	0	1	0	1
Total	9	10	29	2	50

Overall, the data show that most of the surveyed students of mathematics and science subjects did not consider teacher education. Nonetheless, some students do consider applying for teacher education. The proportion of those who possibly and definitely consider applying for teacher education is relatively similar in size. The smallest proportion of the two study participants indicated an "I don't know". Due to the small proportion and the ambiguity of this answer, it was decided to conduct further group comparisons only based on the "yes", "maybe", and "no" answers.

4.1.2 Motivations for teaching

Students' motivations for teaching were measured using the FIT-Choice scale. First, data were checked for outliers. Although two outliers were found for the factors of *job security* and *enhance social equity*, the outlier cases were retained to minimise further loss of data.

In the next step, the motivation for teaching was summarised by mean scores for each factor for all participants (*N*=50). As can be seen from the descriptive statistics in Table 8, highest rated motives for teaching amongst mathematics and science students included *intrinsic value M*=5.0 (*SD*=1.6), *prior teaching and learning experiences M*=4.9 (*SD*=1.37) and *perceived teaching ability M*=4.83 (*SD*=1.58). The lowest-rated motive was choosing teaching as a career due to *social influences M*=2.91 (*SD*=1.40). Other motives that can be assigned to the superordinate factors of *personal* and *social utility*, such as *job security* and *time for family*, *shaping the future of children/youth*, *promoting social justice*, *making a social contribution*, and *being able to work with children/youth*, were rated in between.

Table 8. Descriptive statistics of the subscale motivations for teaching.
Number of participants (*N*), medians [minimum; maximum], means and standard deviation.

Variable	*N*	Minimum	Maximum	Mean	Standard Deviation
Perceived Teaching Ability	50	1.00	7.00	4.83	1.59
Intrinsic Value	50	1.00	7.00	5.00	1.61
Job Security	50	1.00	7.00	4.67	1.27
Time for Family	50	1.33	7.00	4.32	1.41
Enhance Social Equality	50	1.00	7.00	4.58	1.46
Make Social Contributions	50	1.00	6.50	4.24	1.52
Shape Future of Children/Adolescents	50	1.00	7.00	4.89	1.65
Work with Children	50	1.33	7.00	4.91	1.37
Social Influences	50	1.00	5.67	2.91	1.40
Valid *N* (listwise)	50				

Based on the mean values, hypothesis 1.1 can be confirmed, which states that mathematics and science students rate *intrinsic value*, *prior teaching and learning experiences*, and *perceived teaching ability* as the most important factors for choosing a teaching career compared to other motivational factors.

Further descriptive statistical analysis demonstrated a difference in the mean ratings for factors of *motivation for teaching* in relation to the *intention to apply for teacher education* (yes: *n*=9, maybe: *n*=10, no: *n*=29). The different mean values can also be recognised in the clustered mean value diagram for factors of the subscale motivation for teaching in Figure 7.
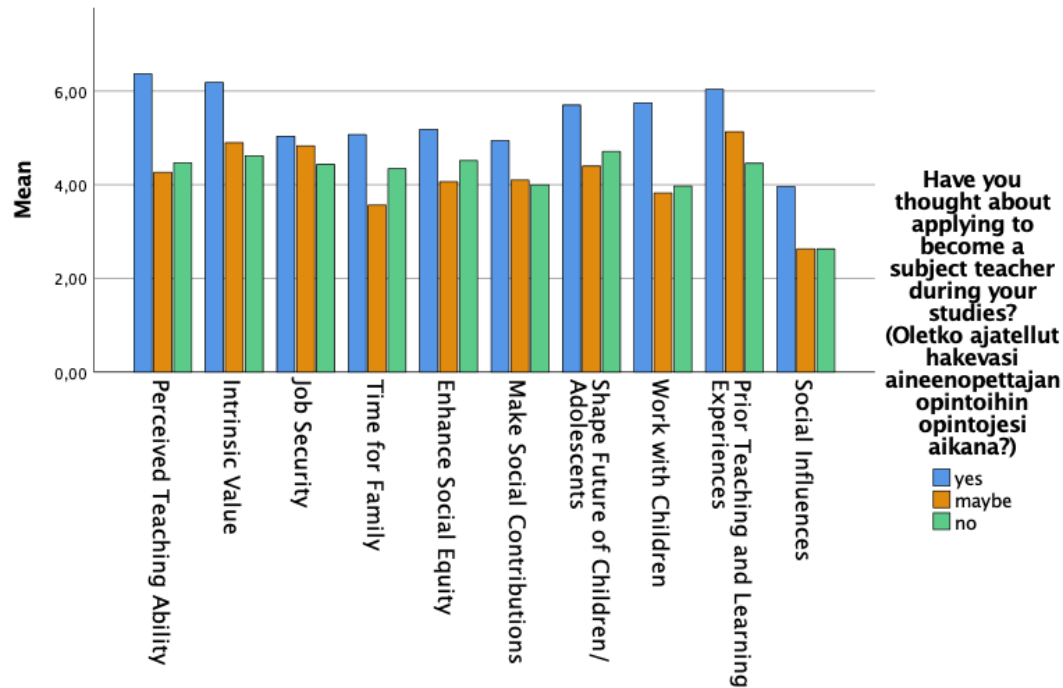
Figure 7. Clustered bar mean of subscale motivations for teaching according to student's intention to pursue teacher education.

To test the significance of the differences, a non-parametric *Kruskal-Wallis test* was conducted. Following Field (2013), this robust test was chosen, as a previously applied *Shapiro-Wilk-Test* indicated a violation of the normal distribution assumption for several factors in each group. Although the violation of the normal distribution could be ignored for a sample of 30 or more due to the central limit theorem, the retention of outlier values requires the application of a robust test (Field, 2013). In addition, the test of variance homogeneity by *Levene's test*, which is a prerequisite for a *single-factor analysis of variance* (ANOVA), showed that the assumption of variance homogeneity is violated for several factors of the scale. Therefore, the robust Kruskal-Wallis test was used, for which the prerequisites that the dependent variable is at least ordinally scaled and that there is an independent variable on the basis of which the groups to be compared are formed are fulfilled (Field, 2013).

The results of the Kruskal-Wallis test show that the intention to apply for teacher education has an influence on some aspects of motivation for teaching, namely *perceived teaching ability* (Chi^2 = 13.54, p = .001), *intrinsic value* (Chi^2= 6.69, p = .035), *work with children* (Chi^2= 10.96, p = .004) and *prior teaching and learning experiences* (Chi^2= 9.94, p = .007).

For each of these variables, box plots in Figure 8 show the different distributions according to the group. The box plots indicate significant group differences for all variables, the responses of the "no" group show a wide dispersion compared to the "yes" and "maybe" groups. In

addition, differences in the median for the groups studied on all variables can be assumed based on the graphical representation.
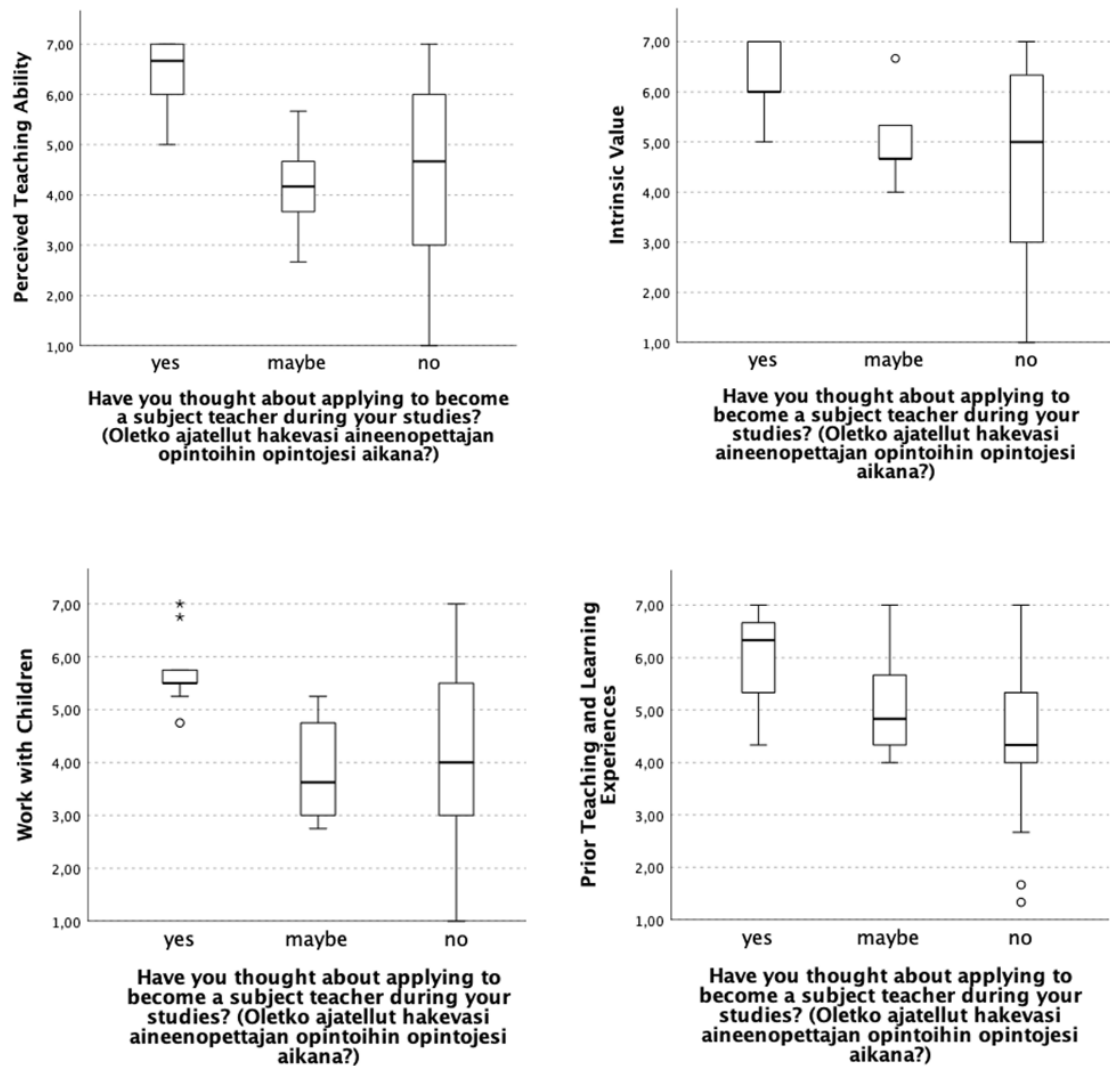

Figure 8. Box plots.
Independent-Samples Kruskal-Wallis tests for variables perceived teaching ability, intrinsic value, work with children and prior teaching, learning experiences and grouping variable "Have you thought about applying to become a subject teacher during your studies?" in groups "yes", "maybe" and "no".

Subsequent *post hoc tests* (Dunn-Bonferroni tests) indicate regarding the motive *perceived teaching ability*, both groups "maybe" and "yes" ($z =3.37$, $p =.002$), and the groups "no" and "yes" differ significantly ($z =3.28$, $p=.003$). It can therefore be assumed that those who aspire to teacher education perceive teaching abilities as a more important motive compared to those

who may or are not interested in teacher education. The effect size is small with $r =.07$ (maybe-yes) and strong $r=. 53$ (no-yes) according to Cohen (1992).

With regard to the *intrinsic value*, post hoc testing indicated a significant difference only for the groups "no" and "yes" ($z =2.43$, $p =.045$). Therefore, those who aspire to teacher training differ from those who prefer an alternative career in the intrinsic value of teaching. Accordingly, working with children emerges as a more important motive for applying for teacher education for those who aspire to teacher education than for the other groups. With an effect size of $r =.39$, according to Cohen (1992), a medium effect can be assumed.

Concerning the factor *work with children*, the groups "maybe" and "yes" ($z = 3.05$, $p = .007$) differ significantly as well as the groups "no" and "yes"($z = 2.93$, $p = .001$). A strong effect ($r =.69$, maybe-yes) and a medium effect can be assumed ($r = .48$, no-yes) (Cohen, 1992).

Finally, post hoc testing revealed a significant difference in the factor *prior teaching and learning experiences* between the group with and without an intention to pursue teacher education (no-yes, $z = 3.14$, $p =.005$). Therefore, it can be assumed that prior teaching and learning experiences are a more important motive for teaching for those who want to undertake teacher education than for those who are not interested in it. In relation to this motive, a strong effect size of $r =.51$ can be assumed (Cohen, 1992).

In all other motives for teaching, the groups do not differ significantly according to the results of the Kruskal-Wallis test. However, due to the small sample and differences in group sizes, these results should be regarded with caution. Therefore, hypothesis 1.2 stating that motivation for teaching differs in relation to students' intention to pursue teacher education can be partially confirmed.

4.1.3 Perceptions of teaching

Perceptions for teaching were as well assessed using the FIT-Choice scale. A check for outliers indicated one outlier on the variable *social status* in case 21. However, to avoid the loss of data from the rather small sample maintaining the outlier value was decided.

Furthermore, *perceptions of teaching* mean scores for each factor were assessed. As summarised in the descriptive statistics in Table 9, participants ($N=50$) generally perceived teaching as a career as high in demand and less high in return. On the one hand, participants rated teaching as high expert career $M=5.23$ ($SD=1.25$), requiring a good level of specialised

professional and technical knowledge. Furthermore, participants answering the online survey rated teaching as demanding *M*=5.52 (*SD*=1.02) in terms of its emotional demand and its workload. On the other hand, the teaching profession was seen as a career that, on average, is associated with a rather high social status *M*=4.48 (*SD*= 1.05) but with a less high salary *M*=3.81 (*SD*=1.20). Social dissuasion, i.e. social influences that militate against a career as a teacher, were least perceived by participants *M*=3.35 (*SD*=1.35).

Table 9. Descriptive statistics of the subscale perceptions of teaching.
Number of participants (*N*), medians [minimum; maximum], means and standard deviation.

Variable	*N*	Minimum	Maximum	Mean	Standard Deviation
High demand	50	3.33	7.00	5.15	1.02
Expert Career	50	2.50	7.00	5.23	1.25
Social Status	50	1.60	6.80	4.48	1.05
Salary	50	1.00	6.00	3.81	1.20
Social Dissuasion	50	1.00	6.50	3.04	1.41
Valid *N* (listwise)	50				

Based on the mean values, hypothesis 1.3 can be confirmed, which states that mathematics and science students perceive the teaching profession of higher task demand and lower task return.

With regard to the *intention to apply for teacher training* (yes: *n*=9, maybe: *n*=10, no: *n*=29*)*, descriptive statistics showed large differences, especially with regard to the factor *social dissuasion* (see Figure 9).
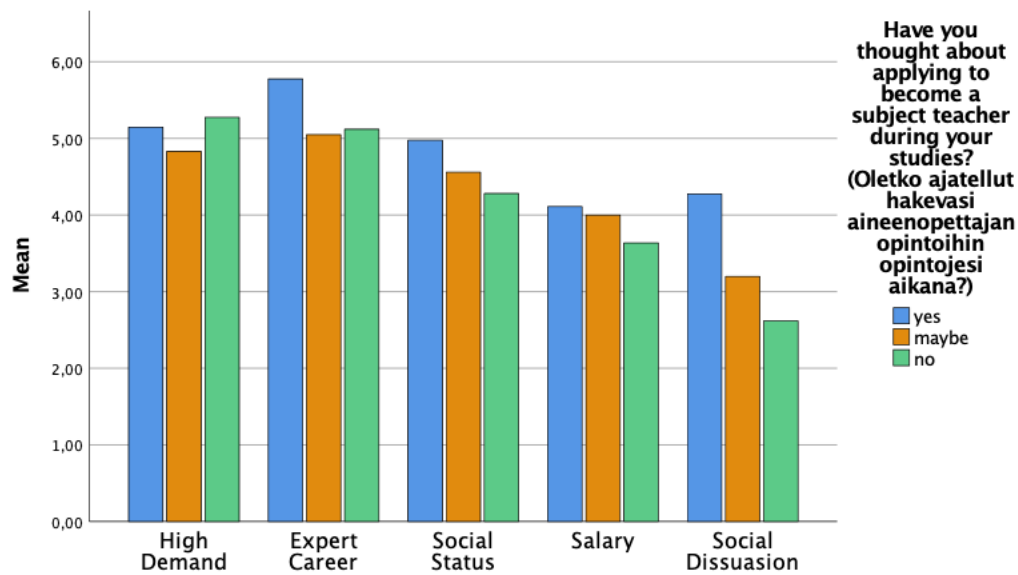
Figure 9. Clustered bar mean of subscale perceptions of teaching according to student's intention to pursue teacher education.

Based on violations of the prerequisites for an ANOVA, the non-parametric Kruskal-Wallis test was again applied to the factors of the scale *perceptions of teaching*. In fact, the calculation of the Kruskal-Wallis test showed a significant difference in *social dissuasion* in relation to the intention to apply for teacher training ($Chi^2 = 9.09$, $p = .011$). The graphical representation of the variable suggests strong differences in the median of the groups. Furthermore, the graphical representation indicates outliers in the distribution of the "yes" group.
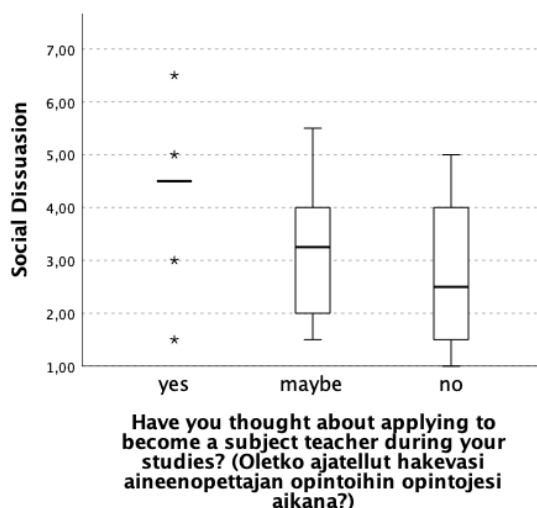

Figure 10. Box plots.

Independent-Samples Kruskal-Wallis test for variable *social dissuasion* and grouping variable *Have you thought about applying to become a subject teacher during your studies?* in groups "yes", "maybe" and "no".

The successive post hoc Dunn-Bonferroni test illustrated that the groups that do and do not intend to apply for teacher training differ significantly in the factor of *social dissuasion* ($z=3,24$, $p=.004$). Accordingly, it can be assumed that those who are interested in teacher education perceive more voices in their social surrounding that oppose a career in teaching compared to participants, who do not intend to pursue teacher education. Referring to Cohen (1992), the effect size of $r=.53$ can be interpreted as a strong effect. However, as with *motivation for teaching*, results regarding *perceptions of the teaching profession* should be viewed with caution due to the sample size and uneven distribution across groups. As a significant group difference can only be found in relation to one factor of perception of teaching, due hypothesis 1.4, which states that the perception of teaching differs in relation to the intention of the students to complete teacher training, can be partially confirmed.

4.2   Qualitative findings

The qualitative research was conducted to explore answers to the following overarching research question: How is the career motivation of Finnish student teachers of mathematics and science subjects affected by their experiences during academic and pedagogical education? This research question is addressed by answering the previously defined sub-questions.

4.2.1   Motivations for teaching

In the interviews with the student teachers for mathematics and science, many factors were identified for the choice of the teaching profession. These factors can be broadly categorised into two groups – firstly, the retrospective reasons for selecting the teaching profession based on past events, experiences, or other factors of the student teachers, and secondly, the aspects of the teaching profession that can be seen as motives for aspiring to work as a teacher in the future.

As retrospective reasons for the choice of the teaching profession, the comparison with other career options, the familiarity of the teaching profession, prior teaching experiences, role models, social influences, and teaching as only career plans were mentioned by the study participants. One of the two most frequently cited reasons for choosing the profession was role models. In this study, five out of seven student teachers reported that observing teachers who served as role models contributed to their desire to become teachers.

For example, S5 describes as follows: "if I reflect even further like to before university, I have had very great teacher role models, who could be a big reason why I would like to be a teacher [as well]".

The second reason described by five out of seven study participants was the comparison with other career options. For example, S1 describes the comparison with a career in economics:

> I also applied for [an] economics school at first. But then I opened the books for applying for the entrance exam and I was thinking that: [What is this?] I don't want to read this! And then I was like: OK, I like math and I like teaching. So, maybe I should just go there and not really care about the money as much if I have already experienced something that I really like to do. Why wouldn't I want to do that as a job really? Not just thinking about being a teacher but actually doing that.

A reason reported by four out of seven student teachers for their career choice was social influence meaning the encouragement and the belief in their teaching skills of important others contributing to the pursuit of a career in teaching. For instance, S7 described that they felt supported by their family members and their teacher to consider the profession of teaching:

> My mom told me that I would make a great teacher and a lot of other family members told me that I would make a great teacher and then I would start to think: "Well yeah, I would make a great teacher". Maybe that's where it came from. And then in high school my biology teacher always like praised me about my ability to explain difficult things in an easy way, so maybe that contributed as well.

Moreover, three out of seven highlighted prior teaching and teaching-related experiences, such as being a trainer in a hobby, tutoring friends, family, or other students at school and having a leading position in the army training impacted their decision to become a subject teacher, like S1 described as following: "Those two experiences like the tutoring and then the army were like the factors that really made me to decide to go study mathematics. And then also to commit to become a teacher".

Based on the frequency of the factors mentioned in this study, previous learning experiences of teachers as role models, but also their own teaching experiences, social reinforcement as well as the examination and comparison with other career options seem to be important reasons for choosing a career as a teacher.

Motives, i.e. aspects of the teaching profession, which influenced the student teachers' wish to work as a teacher in the fu for a career in the teaching profession are numerous. Motives mentioned by the student teachers are an activity of teaching, facilitation of learning, lack of subject teachers in mathematics and sciences, practical aspects of the teaching profession such as holidays and wages, societal aspects of the teaching profession, subject proficiency, work environment, and working with children or adolescents.

The activity of teaching was most frequently mentioned by student teachers as motive for choosing the teaching profession. Five out of seven study participants implied the desire to teach as a motive, like S7 did: "My main reasons for wanting to get into teacher studies? Well, because I want to become a teacher obviously".

Two motives reported second most by four out of seven interviewees depicted the facilitation of learning and working with children and adolescents, as described by S6: "I guess, I just enjoy teaching other people and watch them learn" and S4:

> Maybe the interaction with the students. That makes my day every day when I see their eyes light up when they figure something out. Or just in general speaking with them [the students] about anything. That is the best part of being a teacher that one can be [the student's] safety net and they can talk to you about anything.

Hence, the teaching activity, working with the pupils, and facilitating their learning are essential motives for choosing to be a teacher of mathematics and sciences based on student teacher's ratings at the end of their studies.

4.2.2 Motivational development throughout teacher education

The interviews with student teachers revealed that both academic and pedagogical training play a crucial role in motivating them to pursue a career as subject teachers for mathematics and science. The experiences gained during the education can lead to motivation sustainment on the one hand and motivation changes on the other. As can be seen in Figure 11, two out of seven interviewees reported that they maintained their high motivation to become teachers over the course of their teacher education. For instance, S2 stated the following: „So, I have known quite a while and when I came to university, I knew that I want to become a teacher, and that has stayed stuck to me all these years".
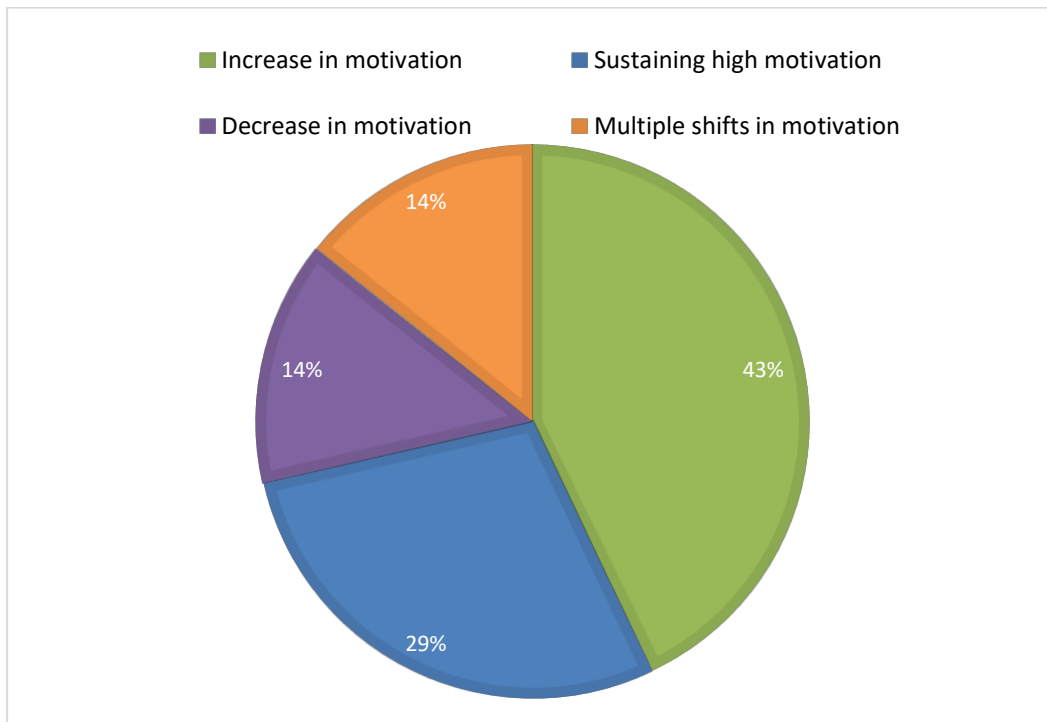
Figure 11. Motivational development of student teachers.

Most of the interviewed student teachers, however, reported a shift in their motivation for the career in teaching mathematics and science subjects. As visualised in Figure 12 exhibited 71% of the study participants shifts in their motivation to enter the subject teaching profession, which are an increase and decrease of motivation or multiple shifts throughout their study time. Three of the seven interviewees described a strengthened motivation to pursue a career in teaching in their academic or pedagogical training. A motivational shift that occurred during the academic studies was described by S4 as following:

> Yes, I had an idea that I wanted to be a teacher, but I was not 100% sure. After [a presentation of different study and career options] I was 100% sure that I would like to be a teacher.

The student teacher, hence, describes a change from uncertainty about their career choice to a high job motivation for the teaching profession in mathematics and science subjects. Furthermore, two out of seven participants in this study reported an increase of motivation during their pedagogical studies, like S6 described:

> I was pretty sure that [teaching] is what I want to do in the future and during the year [of the pedagogical studies] it just got stronger, because I liked planning the lessons and the practical studies that we do in physics.

An opposite shift in motivation, namely from high job motivation at the beginning of the studies to being uncertain about the career choice of subject teaching in the mathematical and science at the end of the pedagogical studies was reported by S3 in this way:

> So, it is kind of pushing me away because I'm not like prepared to go [to the chemistry teacher job] even though I should be and it like made me think that: "Do I want to be a chemistry teacher?" I know that I want to be a teacher but is chemistry the [right] thing?

Only one of the study participants described more than one motivational shift throughout their studies. First, S7 reported a high job motivation throughout their academic studies, which changed with the application and entrance to the pedagogical studies:

> At the point when I started the [pedagogical] studies I wasn't [sure that I wanted to be a teacher] because there's this entrance interview you have to go through before you get accepted [to the studies].[…] Yeah, it was maybe that I just wasn't able to say the things they were wanting to hear but I don't know something went wrong. So, that took some of the motivation away.

Despite this decrease in the job motivation at the beginning of the pedagogical studies, the student teacher reported an increase of job motivation throughout the year of pedagogical studies as they stated: [My motivation] did increase again during the pedagogical studies".

In addition to these motivational developments described, two out of seven student teachers mentioned that their motivation to work in a particular type of school, namely general higher secondary school (10th to 12th grade in Finland), had changed due to the possibility of teaching in upper secondary school (7th to 9th grade) as part of the pedagogical studies. After teacher training, student teachers were willing or even wish to work in upper secondary school.

4.2.3 Determinants of motivational development

Pedagogical studies appear to play a vital role in the motivational development of student teachers, as evidenced by the chronological sequence of motivational changes illustrated in Figure 12. The majority of these changes are reported to occur during this period, suggesting that pedagogical studies are a critical phase for motivational development.
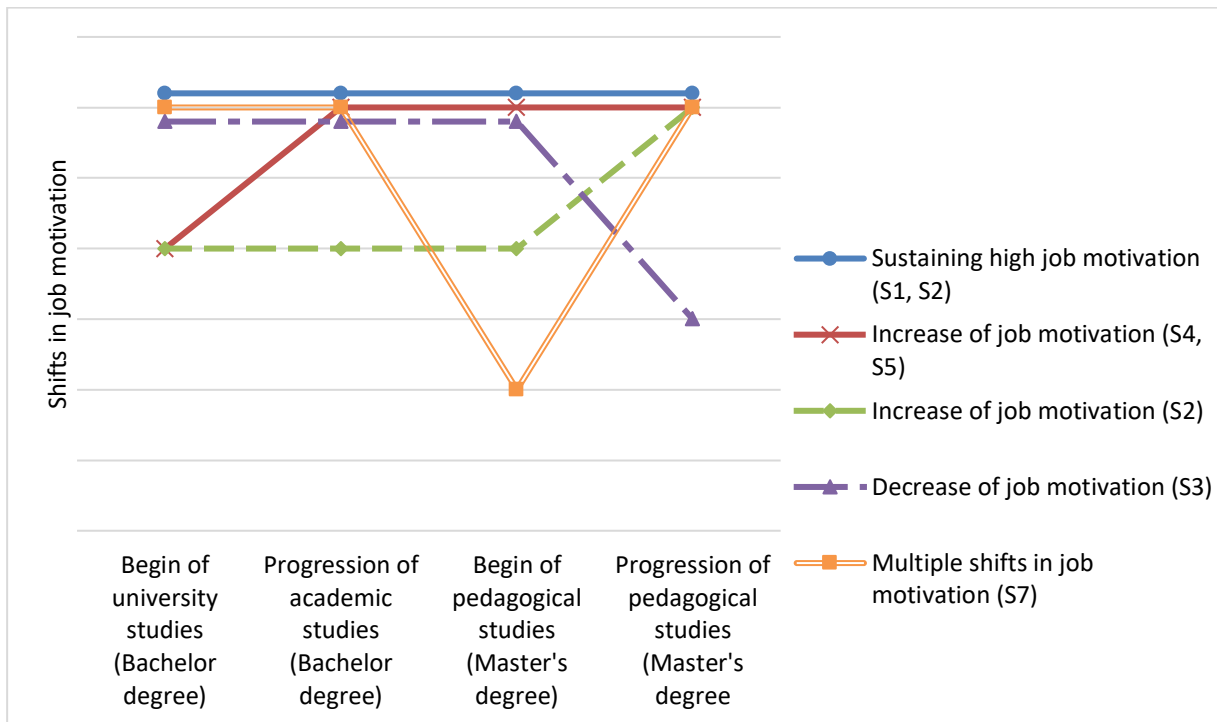
Figure 12. Chronological sequence of motivational development.

For the motivational development of the student teachers during the pedagogical studies, two determinants seemed to be particularly prominent. On the one hand, the motivation of the student teachers appears to be impacted by critical individuals, specifically the supervising teachers named by all interviewees, as well as other student teachers in the pedagogical teacher training. The student teachers reported feeling encouraged by the supervising teachers, as S2 formulated: "Yes, they [the supervising teachers] definitely do encourage, and they criticise when it needs to be said". However, if the cooperation was difficult, supervising teachers could also be a source of frustration and discouragement for the student teachers, as S4 described:

> Now it is more difficult, because the supervisor wants everything to be done his way, and I would like to do things my way and try new things. And he just really doesn't seem to enjoy it. And I feel, I am putting hours in and work towards things that I would like to do and when I present them to the supervisor then he is like: Nah, do it some other way!

Two of the study participants also pronounced on the role of their fellow students. S6 described the positive impact of the cooperation with other student teachers as follows: "Well, the group (of student teachers) that was in the pedagogical studies, they are great people, so we have the same interests. And if I didn't understand something [the fellow students] were

always ready to help me". S3, in contrast, described how the comparison with other student teachers can also cause doubts about one's own career choice:

> I was kind of like comparing myself to the others and I was sort of like getting the feeling that I'm not completely on the same wavelength. I didn't know why, but I think I was more of like a bubbly person, I'm not sure if it's like bad in any way. But I was kind of like not being as serious and down to earth and something like that. So, I was kind of feeling not like [the other teacher students]. So, that was one thing that make me think that are the mathematical subjects for me.

On the other hand, the teacher student's sense of their professional competence appears as relevant for motivational development. Five out of seven interviewees reported an increase in their job motivation due to the perception of their own professional growth in teaching and working with students. For example, S2 describes as follows:

> Well, I have been positively surprised, how good I am when dealing with children. Like these teacher studies that was the only thing that I was very sceptical or unsure about. Mostly is that, am I like good enough for my social skills to deal with like children or especially if there is a little bit of harder subject and I need to teach. But as I have done these pedagogical studies, I have seen that even like how the harder kids are. I can deal with them surprisingly well. So, that has definitely boosted my motivation and I guess my motivation essentially.

On the contrary, the perception or feedback from others can be an experience of threat to the sense of professional competence, leading to a motivational downward shift. One such threat to the sense of professional competence is the poor evaluation in the selection process for pedagogical studies reported by S7, which was described as follows: "Then these people [interviewers in the selection for the pedagogical studies] are telling you like: Nope, you're not good for this job". Furthermore, S3 expressed the feeling that they were not sufficiently prepared for the teaching profession, although they had undergone teacher education:

> But then actually it was in the [pedagogical studies], when I was learning about the school system and it kind of changed my point of view, because I realised that it wasn't like solely about the pedagogy. It was so much about the taking care of these young people side – also like educating them like to be a person, not only about the subject things. And it was like the more I learned about the school system, the more I realised that it was kind of very little about this subject and the pedagogy. Well, that was interesting but for me it happened in a way, that I think that one year [of pedagogical studies] was a bit too short. So, I didn't have the time to practice the pedagogical skills enough.

5   Discussion

The results of this study have provided insight into the initial motivation and motivational development of Finnish student teachers of mathematics and science. This chapter contains a summary, interpretation, and reflection of the study's results. The limitations and possible consequences of the study design are discussed as well as the implications for the interpretation of the results. The chapter ends with several recommendations for future research and practical implications.

5.1   Summary of key findings

The objectives of the research conducted in this thesis are to explore the factors that impact the decision of first-year mathematics and science students to pursue a career in teaching, as well as the motivational development during teacher education of subject teacher students of mathematics and science in Finland.

Using statistical analysis of questionnaire data, the study investigated the factors influencing first-year mathematics and science students' decision to become teachers. As expected, the study found that *intrinsic value*, *prior teaching and learning experiences*, and *perceived teaching abilities* are the most important factors in choosing a teaching profession. Moreover, the study confirmed the assumption that first-year mathematics and science students perceive the teaching profession as a task with higher demands and lower returns. In addition, the study found that motivation for the teaching profession and perceptions of the teaching profession differed partially according to students' intention to pursue teacher education. Significant group differences were found for the variables *perceived teaching ability*, *intrinsic value*, *prior teaching and learning experiences*, *working with children or adolescents*, and perceptions of *social dissuasion*.

Regarding the motivation for the teaching profession and the motivational development during teacher education of student teachers of mathematics and science, results were obtained by means of qualitative content analysis of semi-structured interview data. The study indicates a variety of reasons and motives that student teachers reported at the end of teacher education for their career decision to become a subject teacher. On the one hand, significant retrospective reasons, such as teacher role models, previous teaching experiences, social reinforcement for the career choice in teaching as well as the comparison with other career options could be identified as decisive for the career choice. On the other hand, motives

associated with the teaching profession appear to be important for the career choice for teaching, such as the wish to teach, to work with students, and to facilitate learning.

Concerning motivational development, study results indicate that motivation for the profession as a subject teacher of mathematics and science is subject to change during teacher education. In this study, three main motivational developments for a career in teaching the subjects of mathematics and sciences could be found. While most student teachers reported maintaining high levels of motivation or experiencing an increase in job motivation during their training, some student teachers experienced a decline in job motivation and even considered changing their career path away from becoming a subject teacher of mathematics and science. The study also indicates that motivation towards the teaching profession can exhibit fluctuations during the education period, with both upward and downward trends in motivation being observed in the present data. Moreover, the motivation to work at a specific type of school can change during teacher training.

Most of the motivational changes were reported during the pedagogical studies. The pedagogical studies are therefore considered a critical phase during teacher education for motivational development. The perception of one's own professional development as well as the socio-professional environment, namely the relationship to the supervising teachers and to the fellow students, appears to be determinant for the student teacher's motivational development.

5.2 Contributions to teacher motivation literature

This section presents the analysis and interpretation of the results obtained in this thesis in relation to the existing literature. For this purpose, the procedure and the results of this study are first reflected globally. This is followed by a reflection and interpretation of the results in relation to the first research question, which was investigated using quantitative research methods. Subsequently, the second research question will be addressed, which was investigated in this thesis with the help of qualitative research methods.

5.2.1 Motivation for teacher education and the teaching profession

This thesis was stimulated by the impending shortage of subject teachers of mathematics and science in Finland, which led to an investigation of the reasons why students of mathematics and science choose a career as a teacher. To develop a holistic understanding of the motivational factors that shape the career choice to become a subject teacher in mathematics

and science, this study involved an investigation of the initial motivation for entering teacher education as well as the development of motivation during education. This comprehensive approach follows the recommendations of Blustein (2006) and is a response to previous research highlighting the importance of examining the impact of teacher education experiences on student teacher's motivation (Richardson & Watt, 2010; Roness & Smith, 2010; Sinclair, 2008)

To explore both initial motivation and motivational development for teaching, this study combined the FIT-Choice model by Watt and Richardson (2007) with Kelchtermans' personal interpretative framework (1993, 2009). This theoretical combination was considered possible insofar as both theories incorporate comparable and complementing elements. On the one hand, the theoretical models are similar, as the elements of socialisation influences, self-perception, and task demand and returns of the FIT-Choice model are contained in the professional self-understanding of the personal interpretative frameworks. On the other hand, the FIT-Choice model lacks consideration of knowledge, skills, and experiences gained throughout teacher education, which in turn are contained in the subjective education theory of the personal interpretative framework. Based on this combination of theories and the subsequent mixed-method approach of quantitative and qualitative research methods, it could be shown that students of mathematics and science hold several different motives and perceptions regarding the teaching profession, in relation to their intention to become a teacher. These initial motives for teaching, such as *intrinsic value*, *prior teaching and learning experiences*, *perceived teaching abilities* seem to be essential for choosing a career in teaching. Moreover, Finnish subject students perceive that the teaching profession entails expertise and high demands but lower status and salary, seem to be essential for entering the teaching profession. However, within teacher education, and especially in the pedagogical studies, the understanding of the self as a teacher and of the profession of teaching changes, based on the student teacher's sense of competence and the collaboration with supervising teachers and fellow student teachers. This changed understanding of the profession and of oneself as a teacher, may eventually affect the motivation to enter the profession of subject teacher in mathematics and science after graduation. Thus, the results of this study can confirm Sinclair's notion (2008) in the Finnish context that initial motivation to enter teacher education is important, but the motivation to teach continues to develop over the course of teacher education.

5.2.2 Initial motivation for teaching of Finnish mathematics and science students

In this thesis, Finnish mathematics and science students were for the first time explicitly examined for their initial motivation for and perceptions of teaching. For this examination, the FIT-Choice scale developed by Watt and Richardson (2007) based on the holistic FIT-Choice model, which was validated for the Finnish education context by Goller and colleagues (2019) was applied to students of mathematics and science. Despite the previous validation of the FIT-Choice scale in the Finnish context, no valid and reliable measurement could be made in this study. The limitations resulting from this will be discussed in more detail in section 5.3.2. Nevertheless, in the following the interpretation of the results with regard to the factors for a possible career choice of the subject teaching profession will be discussed in more detail.

Motivations for teaching

In this study, the factors *intrinsic value*, *prior teaching and learning experiences*, and *perceived teaching abilities* were rated on average as most essential for a career choice in teaching by students of mathematics and sciences. Thus, socialisation influences, namely students' learning experiences in school, self-perception of their teaching abilities, and intrinsic value in the profession are identified as important motivations for choosing a career as a teacher. On average, the factors of *personal* and *social utility value* are considered less important for the career decision by the Finnish students. No precise statements could be made about teaching as a *fallback career* due to statistical problems. Nevertheless, with these results, the findings of Goller et al. (2019) can be confirmed with regard to the group of Finnish subject teachers. Furthermore, the results are comparable with the findings of the study by Watt et al. (2007), which investigated the motivation of Australian student teachers in STEM subjects. Likewise, Australian students had also named, among other things, *perceived teaching ability*, *intrinsic value,* and *previous teaching and learning experiences* as significant factors for choosing a career as a teacher. In contrast to the Australian STEM student teachers, the Finnish mathematics and science students considered the social utility value variables *desire to make a social contribution* and *to shape the future of children/adolescents* to be less important on average. The results of this study also support Watt and Richardson's original study using the FIT-Choice model in 2006 in which *perceived teaching ability* and *intrinsic value* were also identified as the main motivational factors for career choice as a teacher. Other studies that applied the FIT-Choice scale in the European context also came to similar results (e.g. Fokkens-Bruinsma & Canrinus, 2012; Jugović et al.,

2012; König & Rothland, 2012). Thus, the findings of this study may be consistent with the argument of Goller and colleagues (2019), who suggest that certain motivations to become a teacher may be ubiquitous.

In this master's thesis, group differences in motivation for teaching according to student's intention to become a teacher were exploratively investigated. Group differences were found in the factors of *perceived teaching ability*, *intrinsic value*, *working with children, and prior teaching and learning experiences*. However, it should be noted at this point that the groups were very unbalanced in the number of study participants in each group. Nevertheless, those interested in a career as a teacher agreed on average that the variables mentioned above were more important than those who were only possibly or not at all interested in the teaching profession. Accordingly, those students who have the intention of pursuing a career in teaching agree that such variables are of greater importance, which was also named in the above-mentioned international studies as essential motives for choosing a career in teaching. These different views regarding these central motives could be explained by the fact that students who are interested in becoming a teacher have already thought more intensively about the career choice to become a teacher and reflected on the factors that are in favour of this career choice.

Most differences exist between the group of students who can imagine becoming a teacher and the group in which the study participants have no intention of undergoing teacher education. Based on the broad dispersion of results within the group without intention to pursue a career in teaching, it could be assumed that the group members are heterogeneous in their views. Among the study participants who have no intention of becoming teachers, some find the motives of *perceived teaching ability*, *intrinsic value*, *working with children*, and *prior teaching and learning experiences* to be important factors for choosing a career in teaching. Others, however, do not seem to consider these factors crucial when applying to study teaching, either because they do not consider them relevant to the hypothetical scenario of aspiring to a teaching profession or because they do not consider these factors important in general if they are not interested in the teaching profession. It is also possible that the variety of responses within the "no" group can be attributed to different levels of consideration given to a teaching career. Some participants may have already thought about pursuing a teaching profession but ultimately decided against it. As a result, they may still have insights into which factors would have been crucial if they had chosen this path. On the other hand, other participants in the "no" group may have dismissed a teaching career from the beginning and

may not have given much thought to the factors that would support a career choice in teaching.

The group who indicated that they might choose teacher education may consist of individuals who are still uncertain about their career path and have not yet made an informed decision about their future occupation at the time of the survey. Consequentially, they may still be unsure about how to classify the different motives for choosing a teaching profession. This explanation is reasonable considering the statistics provided by Statistics Finland (2021) in Figure 13, which show that only about two-thirds of new students in mathematics and natural sciences complete a bachelor's degree within three years of regular study time. Additionally, many of those students who do obtain a bachelor's degree also pursue a master's degree. As a result, first-year students who may or may not want to become teachers may switch their majors or areas of study during their bachelor's degree programme.
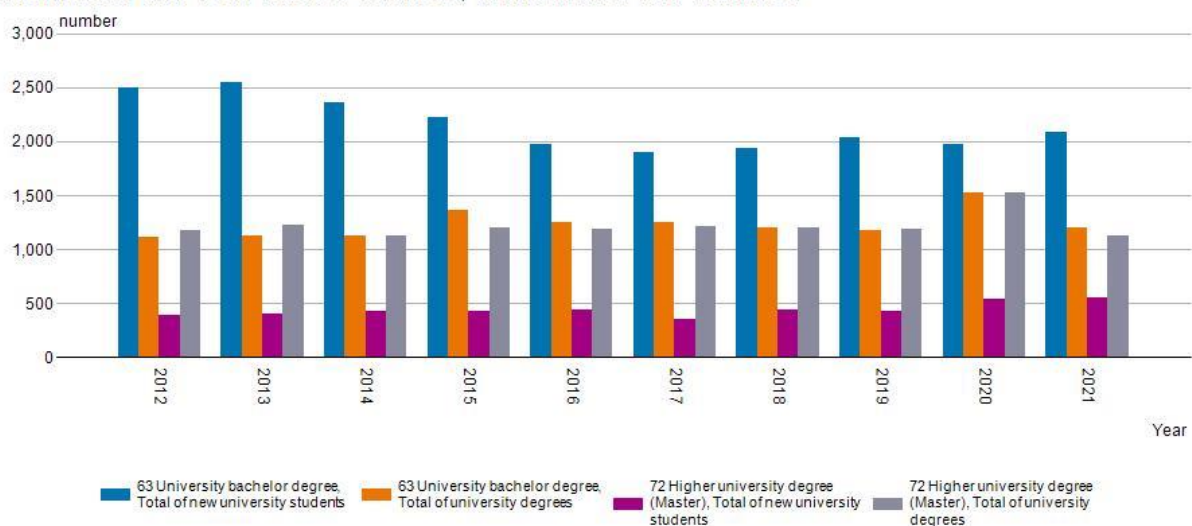

Figure 13. New university students of natural sciences, mathematics and statistics in University's bachelor and master degree, and university bachelor's and master's degrees.

Statistics Finland [University students and degrees (National classification of education 2016) by Year, University], [2021]. Licensed under CC BY 4.0Y).

Perception of teaching

The teaching profession was generally considered a task with higher *demands* and lower *returns* by first-year mathematics and science students in Finland. On average, the participating students assessed that teaching is highly demanding in terms of workload,

emotional effort, and difficulty with work tasks. This high work demand contrasts with a less high perceived task return in terms of high social status or wage. These results are in line with the earlier findings of Goller et al. (2019) related to subject teachers in the Finnish context. These results are moreover consistent with the research by Watt and Richardson with Australian student teachers in general and with regard to STEM teacher students (Richardson & Watt, 2006; Watt et al., 2007). Thus, it could be argued that students of mathematics and science have a rather realistic perception of the teaching profession. But the different views on task demand and task return can also be seen as a perceived mismatch, according to Wang and Houston (2021).

Regarding task return, the average salary of a teacher in Finland is indeed much lower compared to other mathematics and science professions. While the average wage for a teacher in Finland is around 45,800 euros, chemists receive on average 63,800 euros a year, astrophysicists 83,800 euros, and mathematicians up to 92,000 euros a year on average (Economic Research Institute [ERI], 2023a, 2023b, 2023c, 2023d). In this respect, the perception of first-year students of mathematics and natural sciences in comparison to their alternative career options can be considered realistic.

The perception that only a modest social status is associated with the teaching profession, but that this is still below the demand of the teaching profession, contradicts the previous literature. For example, Sahlberg (2013) and the TALIS study (OECD, 2018) highlighted that teaching is a respected profession in Finnish society. One explanation for this perception of teachers' status in society by students could be due to the comparison of the teaching profession with other career paths. For example, Mieg (2022) describes that working in science is seen as a privileged profession that comes with great responsibility. Furthermore, a recent study conducted by Gligorić et al. (2022) underlines that professionals in science fields such as chemistry, physics, and biology hold scientific occupations in high regard for their expertise.

Alternatively, according to Richardson and Watt (2016) and Wang and Houston (2021), the perception of the teaching profession with high demand and lower return could also be influenced by the image of the teaching profession portrayed by the mass media. This media image is likely to have shaped the perception of the profession in the study presented in this thesis. During the first measurement period, which lasted from September to December 2021, the mass media reported extensively on the excessive workload in the teaching profession in

Finland caused by the COVID-19 pandemic. As OAJ (2021) reported, at that time more than half of the teachers had thought about changing their profession away from teaching in Finland.

Significant group differences identified among the study participants in their perception of teaching was related to *social dissuasion*, which refers to the degree to which students were discouraged from pursuing teaching as a career. Students who expressed an intention to become teachers reported a higher prevalence of social dissuasion compared to those who did not want to become teachers. This suggests that individuals who aspire to be teachers may encounter more criticism and negative voices regarding their career choice and the teaching profession. Despite group differences related to social dissuasion, this study found that perceptions of the teaching profession were generally similar across participants. This could be attributed to the participants' limited experience as teachers, which meant that their perceptions of the profession were largely based on their image of what a teacher should be like. This image may have been shaped by their own experiences as pupils, media influences, or societal expectations of the teaching profession.

5.2.3 Motivational development during teacher education

Besides investigating the initial motivation of mathematics and science students, this thesis involved Finnish student teachers in mathematics and sciences who were asked about their retrospective motivational development during their academic and pedagogical education. The investigation of motivational development was conducted using semi-structured interviews following an adapted interview guide by Rots et al. (2012). In the following, the results obtained from the interviews will be interpreted and discussed.

Review of student teacher's initial motivation

Mathematics and science subject student teachers who have undergone academic and pedagogical teacher education report various reasons and motivations that have influenced their decision to pursue a career in teaching. These reasons and motivations include both retrospective and future factors. In terms of retrospective reasons, teacher role models and previous teaching and leadership experiences emerged as important. In addition, social affirmation from important people such as family members and teachers played a crucial role in career choice. These retrospective reasons are consistent with the *socialisation influences* in the FIT-Choice model, especially regarding the factors of *social influence*, and *prior teaching*

and learning experiences. Previous positive teaching experiences could be equated with the *perceived teaching ability* factor of the FIT-Choice model. Furthermore, motives linked to the profession of teaching were reported as important, such as the desire to teach, to work with students and to support student learning. These factors are comparable to the *intrinsic value,* and the *social utility value* of the FIT-Choice model. Accordingly, the findings of the quantitative part of this thesis can be partly confirmed by these qualitative results regarding the key initial motivations for choosing teaching as a career. Similar to these qualitative findings, first-year students of mathematics and science rated *intrinsic value*, *prior teaching and learning experiences*, and *perceived teaching abilities* on average as the most important motivations for pursuing a career in teaching. In contrast to the first-year students, the student teachers regarded social influence retrospectively as a more important motive for their career choice. Nevertheless, based on these responses, it can be assumed that the two cohorts studied in this thesis are relatively similar and their responses are therefore comparable. These comparable results could indicate that similar to Sinclair (2008), students see themselves confirmed in their motives and career choices over time of their education. Alternatively, those who did not see these motives as important may have dropped out of teacher education over time.

Shifts in motivation for teaching

In this study, three major scenarios in student teachers' motivational development were found. First, student teachers of mathematics and science maintained a high motivation for the teaching profession throughout their studies. Second, the motivation for becoming a subject teacher increased over the course of teacher education. Third, student teachers also reported a decline in motivation to enter the subject-teaching profession. Furthermore, multiple fluctuations in motivation for the subject teaching profession occurred during teacher education. The three main scenarios of motivational development correspond to the findings of Rots et al. (2012), who also found increases, sustaining, and decreases in motivation among student teachers during teacher training in the Belgian education context.

In addition, this study revealed that a large share of Finnish mathematics and science teacher students felt an increasing motivation to become subject teachers during their studies. This finding is consistent with Sinclair's (2008) study, which found that many Australian student teachers were encouraged to enter the teaching profession and remained committed to their career choice for teaching throughout their education. Although not all student teachers

reported an increase in motivation, some student teachers reported that they began teacher education with an already high level of motivation that was maintained throughout their studies. This study also suggests that student teachers have preconceived motivations and expectations about the teaching profession, which may be challenged and re-evaluated during teacher education, as noted by Rots et al. (2012) and Sinclair (2008).

Another novel type of motivational change is the observed shift in motivation to become a teacher in a particular type of school. Despite student teachers having already decided on the school type and age group, they want to teach after graduation, gaining experience in a different type of school with a different age group of students can lead to a change in motivation regarding the type of school. Therefore, the opportunity to gain positive experiences in different types of schools may increase motivation to teach in a particular type of school where there may be a more severe teacher shortage, as this study indicates. Consequently, flexible hybrid education models qualifying for teaching at Finnish primary, lower secondary, and general upper secondary schools could also constitute an opportunity to address the emerging shortage of subject teachers.

Based on the interviews conducted, it was found that most of the motivational changes occurred during the pedagogical studies. The pedagogical studies are therefore considered a critical phase for the motivational development of student teachers of mathematics and science. This study result is in line with previous theoretical and empirical literature, which has assumed that practical teacher training is an important experience for student teachers, where they see themselves for the first time as professionals in the role of the teacher as well as in the working context of school (Bullough & Young, 2002; Rots et al., 2012; Smagorinsky et al., 2004). On the one hand, the results of this study support the notion that practical training in schools can lead to a conflict between professional self-understanding and the subjective educational theory formed before and during training (Kelchtermans, 2009; Rots et al., 2012). This tension may arise from the challenges and complexity of the teaching profession, which can lead to doubts and the need to adapt the personal interpretative framework (Rots et al., 2012). This experience could ultimately affect an individual's motivation negatively to enter the teaching profession. On the other hand, this study indicates that the practical experiences gained during pedagogical studies can affirm or positively influence student teachers' professional self-understanding and subjective educational theory. Consequentially, a maintenance or positive correction of student teachers' perspectives in

pedagogical studies could sustain or strengthen their motivation to enter the teaching profession.

During this critical phase of the pedagogical studies, in line with the research findings of Rots et al. (2012), social-professional relationships and the perceptions of professional competence development seem to be crucial for the motivation of Finnish mathematics and science student teachers.

In terms of socio-professional relationships during the pedagogical studies, supervising teachers at the teacher training school as well as peer student teachers were identified as crucial persons for the student teacher's motivational development in this study. These socio-professional relationships may have both positive and negative effects on student teachers' motivation for teaching. Butler and Cuenca (2012) suggest that supervising teachers should ideally assume three crucial roles in their relationship with student teachers as "(1) instructional coach, (2) emotional support system, and (3) socializing agent", serving as a link between theoretical university education and practical school experience (p. 296). Following this suggestion, findings from this study emphasise that it may have a significant impact on student teachers' self-esteem and promote a positive attitude towards the teaching profession if they perceive their supervising teacher at the teacher education institution as a person who guides them, provides instruction and constructive feedback, offers them support and encouragement, and makes them well acquainted with school practices (Rots et al., 2012). However, in line with Rots et al. (2012) the relationship with the supervising teacher can also be a source of frustration and tension, specifically when difficulties arise in the cooperation between the supervising teacher and the student teacher. In this case, the supervising teacher may not be perceived by the student teachers as embodying the before mentioned important three roles, because the supervisor might not provide clear instructions and feedback, emotional support, and assistance for the socialisation within the school context. This kind of mismatch between supervising teacher and the student teacher could have negative consequences for the student teacher's motivation to teach.

In contrast to the study by Rots et al. (2012), in which the perceived collegiality in the teacher training school is suggested as important for motivational development, in the present study the role of the peer student teachers was identified as particularly important in addition to the role of the supervising teachers. According to the Finnish student teachers, the peer group can be perceived as a supportive but also as a discouraging factor, which may have corresponding

effects on the motivation to become a mathematics and science teacher. The perception of support from fellow students may have a positive effect on the individual's motivation as it could address the basic psychological need for relatedness in the sense of the self-determination theory (Deci & Ryan, 2011). According to Deci and Ryan (2011), satisfying this basic psychological need of relatedness could lead to increased well-being, satisfaction, and intrinsic motivation. Regarding teacher education, a study by Kassis et al. (2019) in which 697 student teachers participated, indicated that perceived social support of fellow student teachers has a direct impact on individual satisfaction.

In this study, Finnish student teachers expressed a feeling of being different from their peers in mathematics and science and doubted their suitability as subject teachers in these areas. This perception suggests that social comparison with fellow student teachers may harm the perception of oneself as a teacher and lead to doubts about their career choice. This described effect of social comparison could be explained by applying the traditional model of the internal/external frame of reference (I/E model) (Marsh, 1986). Regarding teacher education, Paulick and colleagues (2017) have illustrated that social comparison can impact student teacher's professional *self-concept*. Self-concept is according to Rogers (1974) a three-part construct, consisting of the ideal self, self-image, and self-esteem which by definition are comparable with the self-image and self-esteem components of the professional self-understanding and the task perception by Kelchtermans (1993, 2009). Correspondingly, it could be assumed that the comparison with fellow student teachers can have an indirect influence on the motivational development of the individual student teacher.

Based on this present study, the sense of professional competence and professional growth could be identified as an important source for maintaining and increasing job-related motivation. Rots and colleagues (2012) assumed that student teachers, based on the theoretical framework of teacher self-understanding, strive to accomplish their professional tasks in a way that is consistent with their task perception. Following this assumption, the study by Rots et al. (2012) demonstrates that a sense of professional competence is essential for the development of positive self-esteem and an important source of motivation for teaching. While this experience of competence can be triggered by feedback from the supervising teacher or important others, self-affirmation through individual positive experiences of mastery is highly relevant. The data of the present study confirm that the perception of student teachers' professional competence in teaching and working with students is considered by most of the participating mathematics and science student teachers

as essential for their job motivation. However, this result is not only in line with the findings of previous research but is also consistent with this study's quantitative data. Likewise, the quantitative data of this thesis revealed that perceived teaching ability is one of the most important motives for choosing a career as a subject teacher of mathematics and science. The positive impact of perceived professional competence on student teachers' motivation could, in turn, be explained through the application of self-determination theory, as the theory's assertion suggests that fulfilling the basic psychological need for competence results in greater intrinsic motivation and well-being (Deci & Ryan, 2011). A decisive role in the experience of competence in the teaching context is attributed to the experience of *self-efficacy* in the classroom (Kassis et al., 2019; Tschannen-Moran et al., 1998).

Nevertheless, according to the interview data, although perceiving professional competence can be beneficial for the motivational development of student teachers, threats to the sense of professional competence can pose negative consequences for the motivation to become a mathematics and science teacher. Similar to Rots et al.'s (2012) study, the results of this study provide evidence that student teachers' perception of professional competence can be strongly impacted when they lack a sense of efficacy and social recognition or receive negative feedback from others. Discrepancies between task perception and the student teacher's subjective education theory and perceived performance as a teacher can result in a threat of the sense of professional competence (Rots et al., 2012). In consequence, as the basic psychological need for competence remains unsatisfied, a decrease in motivation may occur following the self-determination theory (Deci & Ryan, 2011).

In the Finnish education context, the qualitative results of this thesis strongly reinforce the findings of Rots et al. (2012) regarding the influential role of socio-professional relationships and student teachers' sense of professional competence during their teacher education. These factors shape the development of motivation among student teachers, and the quality of socio-professional relationships and the perception of competence, whether positive or negative, can have a profound impact on their motivation to pursue a career as mathematics and science teachers.

5.3 Limitations of the present study

This study has several limitations. Limitations that arise due to the samples examined and the methods applied are identified and discussed in this section.

5.3.1 Examined samples

In this study, two samples were examined. One sample consisted of first-year mathematics and science students from a Finnish university. The other sample consisted of student teachers from the same university who were undergoing or had already completed the pedagogical studies at the end of their studies. Both samples were convenience samples of a rather small size obtained from a single Finnish university, which implies several limitations. Firstly, it cannot be ruled out that this university is idiosyncratic to a certain degree. This aspect is particularly relevant as application processes, structuring, and content regarding subject teacher education, as described in section 2.5.3, are administered differently at the various Finnish universities. For this reason, it cannot be assumed that the samples examined in this study are truly representative of all students and teacher students of mathematics and science in Finland. To achieve better representativeness and generalisability, a balanced sample of students from all Finnish universities could address this problem.

Secondly, limitations result from *convenience sampling*. While a major advantage of this sampling method is that it involves the study of an available group of people with convenience, the samples are most likely subject to bias (Fraenkel & Wallen, 2009). Due to the convenience sampling and the voluntary nature of participation in the study, there is a risk of *self-selection bias*, which according to Fraenkel and Wallen (2009) could affect the validity of the results. Thus, it is probable that only those individuals who hold strong opinions and are willing to express them participated in this study. Persons who are reluctant to express their opinions were probably not included in this study. Following Fraenkel and Wallen (2009), "convenience samples cannot be considered representative of any population and should be avoided if at all possible" (p. 99). In the framework of this master's thesis, however, this sampling method was regarded as the most feasible despite its drawbacks.

Further selection bias may result from not collecting any personal data, such as gender, age, or socio-economic background information. Fraenkel and Wallen (2009) stress that a lack of control for these individual variables "may explain away whatever differences between groups are found" (p. 167). Blustein (2006) also emphasises the need for a holistic approach to assessing career decisions that considers individual and context-specific variables. Concerning motivation for a career in teaching, data could be biased, especially in relation to gender. Gender can have an influence on motivation for teaching as shown on the one hand by the number of women opting for a career in teaching. In Finland, the percentage of female

teachers in comprehensive schools is 78% and in general upper secondary schools 69% (Opetushallitus, 2020). In contrast, however, mathematical and science subjects tend to be considered male domains (Watt et al., 2013). On the other hand, studies examining the factors for choosing teaching as a career using the FIT-Choice scale in relation to STEM subjects found some significant gender differences (Watt et al., 2007, 2013). Accordingly, controlling for individual variables, especially regarding gender would be advisable. Nevertheless, to protect the privacy of the study participants, no individual data was collected in this study. Consequently, this study cannot provide any information on the extent to which individual factors influence initial motivation and motivational changes regarding teaching.

Thirdly, in this study, homogeneity within the sample was assumed regarding the field of study. Fraenkel and Wallen (2009) understand a homogeneous sample as one in which all participants possess a common characteristic. In this study, the common characteristic was defined as the study of mathematics and sciences. No distinction was made for the major subjects studied. Therefore, no conclusion can be drawn on whether opting for a particular major within the subject group of mathematics or sciences has an impact on motivation or the development of motivation for teaching.

Finally, the small sample size posed a challenge in conducting quantitative analyses, especially when conducting an EFA. In addition, only a minority of the first-year students included in the study were either definitely or possibly interested in teacher education, while a larger proportion indicated that they were not pursuing such a path. The limited sample size combined with the significant differences within the sample may have contributed to the validity problems observed in the measurement of the FIT-Choice scale during the EFA. To improve the adequacy of the group comparisons made, larger and more balanced samples would be more appropriate to enhance the validity and generalisability of the study results (Fraenkel & Wallen, 2009).

5.3.2 Applied methods

For the investigation of student's initial motivation for teaching and the motivational development over the span of teacher education, a cross-sectional study design was utilised. Cross-sectional studies examine parallel cohorts sampled relatively simultaneously from a population and can thus "also bear several hallmarks of a longitudinal study of parallel groups" (Cohen et al., 2018, p. 349). However, it is important to note that the results of a cross-sectional study design may not have the same level of validity as a longitudinal research

design that for example follows students from the beginning to the end of their studies. For instance, changes between the studied cohorts could be caused by unnoticed third-party variables. Regarding the cohorts investigated in this study, motivational changes between the beginning and the end of teacher education could be influenced not only by the experiences gained during the studies but also by the consequences of the COVID-19 pandemic on teacher education and the teaching profession. Thus, because cross-sectional studies always measure moments in time and may ignore other factors that might have an impact, this study design "may be ineffective for studying change or causality" (Cohen et al., 2018, p. 349). Instead, Cohen and colleagues (2018) advocate for the study of change using cross-sectional studies, a replication of the study, or the application of trend analyses. In the context of this thesis, however, the one-time implementation of a cross-sectional study was considered most practicable.

According to Bauhoff (2014), cross-sectional studies based solely on self-reported data may have systematic biases. Respondents might provide inaccurate information or use biased heuristics for their responses. Furthermore, "they may also deliberately misconstrue the truth, e.g., to conform to perceived social norms" (Bauhoff, 2014). In relation to the use of the FIT-Choice scale, Goller and colleagues (2019) highlighted that *social desirability* can be a particular concern. Social desirability refers to the inclination of study participants to act in a manner that portrays them positively to others. This desire to project a positive image can undermine the validity of empirical research (Furr, 2010). According to the argumentation of Goller et al. (2019), particularly the factor *fallback career* may be particularly susceptible to social desirability, but also other factors like *intrinsic value* or *time for the family*. It is questionable whether bias due to prevailing social norms could have led to the dysfunction of the *fallback career* variable in this study. Overall, it cannot be ruled out that socially desirable answers led to a distortion of the quantitative results. To determine socially desirable responses, it is crucial to employ items that can measure socially desirable response behaviour, as previously recommended by Goller et al. (2019). Furthermore, it remains open whether interview participants answered in a socially desirable way in the qualitative part of this study. It is conceivable here that reports that emphasised intrinsic motives for career choice and relation to supervising teachers may have been influenced by social desirability. In order to minimise the influence of social desirability in qualitative research, the methods presented by Bergen & Labonté (2020), such as training and debriefing of data collectors and discussions with other researchers to improve research approaches, could be implemented.

However, these rather complex methods for minimising social desirability in qualitative research are difficult to implement in the context of a master's thesis.

After the limitations of the methodological approach have already been discussed in general, limitations regarding quantitative and qualitative methods will be examined in the following.

Quantitative methods

In the quantitative analysis, all outliers were retained to avoid the loss of data in an already small data set. Possible bias in the results cannot be ruled out due to errors and the existence of extreme values in the FIT-Choice scale.

To investigate the initial motivation and perceptions for the teaching profession of mathematics and science students, the FIT-Choice scale translated and validated by Goller et al. (2019) was applied in a modified version in this study. In contrast to Goller and colleagues' (2019) findings, the scale was found to be only partially reliable but not valid in the context of this study. The internal consistency test showed that the scale *motivation for teaching*, except for the variable *fallback career*, had an acceptable to good reliability, whereas the scale *perceptions of teaching* had a poor reliability. For the *perceptions of teaching* scale, it was particularly striking that the overall scale had a smaller Cronbach's α than the subscales. This could indicate that the subscales are not as similar or internally consistent as theoretically assumed.

The impression that the subscales do not accurately reflect the theoretical FIT-Choice model, especially with regard to the *perception of teaching*, was also evident in the EFA conducted. The *perception of teaching* subscales loaded high on three different factors instead of one common factor as expected. Similarly, the *motivation for teaching* subscales did not match the theoretical FIT choice framework. These inconsistencies between the EFA results and the theoretical structure of the FIT-Choice model indicate that the construct validity of the study is insufficient. The problematic reliability and validity of the scale may, on the one hand, be due to the application of the scale to a changed population, namely to first-year students of mathematics and science subjects who have not yet decided on a career in teaching. In particular, first-year students who are not interested in a career in teaching or who have not yet decided on their own career path may not be aware of the factors that influence people's career choices to become teachers. Thus, first-year students' perceptions of teaching may still be strongly determined by perceptions of being taught as a pupil due to a lack of own teaching

experiences. On the other hand, construct validity was assessed using an EFA, although the required sample size and other conditions for conducting an EFA were not met. Therefore, measuring construct validity using an EFA may have also led to invalid results. Nonetheless, based on the overall problematic construct validity and reliability, the psychometric quality of the FIT-Choice scale in this study must be rated as poor.

In conclusion, the informative value of the FIT-Choice scale on initial motivation for the teaching profession in general, but also regarding group differences in intention to pursue teacher education, is strongly limited. Accordingly, no generally valid conclusions can be drawn from the results of the quantitative study. Following this study, the question remains open to what extent the FIT-Choice scale is applicable to a population of students who have not yet decided to pursue a career in teaching.

Qualitative methods

Qualitative data were obtained using semi-structured interviews. For these interviews, an interview guide by Rots et al. (2012) was used, which was modified to fit the research question and adapted to the Finnish research context. While this *interview guide approach* can systematise the data collection, strengthen the comprehensibility of the data, and allows conversational and situational interview conduction, it may also impose limitations (Fraenkel & Wallen, 2009). On the one hand, important topics could be neglected in the interview. On the other hand, the flexible formulation of questions from the interviewer may result in different responses from the participants in the study, which would consequently reduce the comparability of the answers (Fraenkel & Wallen, 2009). It is not possible to determine precisely to what extent these limitations also apply to the interviews conducted in this study.

Interview data were analysed using content analysis. Content analysis as a research method for human behaviour through the analysis of communication is considered by Fraenkel and Wallen (2009) to be "extremely useful as a means of analyzing interviews" (p. 483). However, the researchers also note that providing validity can be difficult when using content analysis, as the true meaning of categories and interpretations may not be indicative of the causes of phenomena, but rather a reflection of them. The content analysis approach also made it difficult to identify connections within a case. A combination of content analysis and *multiple case study design*, as implemented by Rots et al. (2012), could be used for this purpose. Nonetheless, to protect the privacy of the study participants, a detailed case description and case-specific analysis were not included.

5.4 Recommendations for future research and practical implications

In spite its limitations, this study's findings can serve as important starting points for future research on initial motivation and motivational development in student teachers of mathematics and science. Furthermore, the results provide indications for practical implications.

5.4.1 Recommendations for future research

This study was the first to investigate the initial motivation for teaching in mathematics and science students and the motivational development of student teachers of mathematics and science in Finland. Due to the severe limitations of the present study, which result from the samples investigated and the methods used as described in section 5.3, future research should seek to replicate the findings of this thesis.

For future research, it is suggested to 1) study larger samples that originate from more than one Finnish university; 2) collect more personal information to control for variables such as gender; and 3) contain comparable proportions of students from the different mathematics and science programmes to observe the effects of subject choice on motivation for teaching. Furthermore, it is recommended to choose a sampling strategy that allows for greater generalisability and replicability of the results, such as *cluster random sampling*, in which all Finnish universities that train subject teachers for mathematics and science are first identified, and then a fraction is selected and studied (Fraenkel & Wallen, 2009).

In terms of applied methods, based on the limitations associated with a cross-sectional study, future research should include a longitudinal study of motivational development with multiple measurement points over the course of teacher education (Cohen et al., 2018). Moreover, due to the poor overall validity and reliability of the FIT-Choice scale in the data of this thesis, further research is needed to reassess the applicability of the scale for students who have not yet decided to enter teacher education and to confirm the motivations for and the perceptions of teaching among Finnish mathematics and science students and student teachers.

5.4.2 Practical implications

The findings of this thesis can moreover provide initial practical guidance for teacher educators, policymakers, and other stakeholders on how to address the issues related to the recruitment of mathematics and science teachers in Finland.

It can be assumed, following Goller et al. (2019), that some initial motivations for teaching are decisive for the career choice for the teaching profession. These motivations include the joy and interest in teaching, previous learning and teaching experiences, and the sense of possessing good teaching skills. Therefore, it is important to provide individuals with opportunities to gain early teaching experience already during their school years and at the beginning of their subject studies. These early teaching experiences can help individuals discover whether teaching is a fulfilling activity and evaluate their teaching skills through constructive feedback from experienced teachers. Such early experiences can influence their future career decisions. Moreover, these decisive initial motivations for the teaching could be taken more into account in the selection procedures for teacher education.

Furthermore, the results of this study suggest that the mathematics and science teaching profession in Finland is perceived by students as a profession with high workload and as expertise-demanding occupation that offers inadequate salary and status. To attract more young people to this important profession and to address the shortage of mathematics and science teachers, policymakers and education providers need to improve working conditions for teachers, ensure that their salaries are on par with those of other mathematics and science professions, and work to restore the reputation of the teaching profession in Finnish society. Especially in light of the COVID-19 pandemic, these improvements are essential. In addition, to create a more positive image of the teaching profession, the mass media should realistically inform about the work of teachers and highlight the progress already made to improve the teaching profession (Richardson & Watt, 2006).

Given the growing shortage of future mathematics and science teachers, it is moreover crucial to recognise that motivation can change during teacher education, especially during pedagogical studies. To maintain and strengthen motivation, supervising teachers and student teachers need to collaborate supportively during practical training phases. In addition, opportunities should be created for student teachers to assess their professional development and competence.

6   Conclusion

Finland is facing an impending shortage of teachers in mathematics and sciences, as the number of student teachers in these subjects is decreasing (Moilanen & Neittaanmäki, 2021). To address this issue, it is important to understand why individuals choose to pursue teacher education and enter the teaching profession (Rots et al., 2012; Watt & Richardson, 2012). This thesis is the first of its kind that aimed to gain a holistic understanding of the initial motivation and motivational development for becoming a subject teacher of mathematics and sciences. This study applied a mixed-methods design to investigate the initial motivation of first-year students and the motivational development of student teachers in these subjects. The results indicate that while first-year mathematics and science students perceive the teaching profession a demanding job that requires expertise but offers comparatively low pay and social status, they would choose this career based on their intrinsic desire to teach, previous learning and teaching experiences, and their belief in their own teaching abilities. These results were partially confirmed in semi-structured interviews with student teachers who indicated similar motives for choosing the teaching profession. Furthermore, the qualitative analysis of interview data revealed that motivation for the subject teaching profession can change during teacher training. Decisive factors for maintaining and increasing motivation for the subject teaching profession can be the quality of collaboration with supervising teachers and fellow teacher students as well as the self-perception of professional competence during the pedagogical studies.

Although the results of this study are limited due to small sample size and insufficient validity and reliability of the quantitative measurement, they provide important first insights into factors influencing initial motivation and motivational development for teaching mathematics and science. Future research should examine these factors in longitudinal studies to provide further information on effective strategies to address teacher shortages in these important subjects. Overall, this study highlights the importance of initial motivation and perceptions of the teaching profession as factors influencing the decision to study teaching. Furthermore, it underlines the need for improvements to make the profession of mathematics and science teaching more attractive to young people. The study also draws attention to the fact that motivation for the teaching profession can shift during academic and pedagogical training. Therefore, it is crucial to foster supportive collaboration between supervising teachers and student teachers during pedagogical studies and to give student teachers the opportunity to evaluate their professional development.

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Appendices

Appendix 1 KOPTUKE online survey

KOPTUKE

 Pakolliset kysymykset merkitty tähdellä (*)

Tällä kyselyllä pyritään kartoittamaan luonnontieteiden opiskelijoiden kiinnostusta aineenopettajan opintoja kohtaan. Kysely on osa Turun, Tampereen ja Jyväskylän yliopistojen yhteistä KOPTUKE-hanketta, jolla pyritään kehittämään luokan- ja aineenopettajien minäpystyvyyttä tutkivaan oppimiseen liittyen ja kartoittamaan syitä opettajankoulutukseen hakeutumiselle. Kyselyn avulla kerätyt tiedot käsitellään luottamuksellisesti eikä kyselyssä kerätä lainkaan tunnistetietoja.
Vastaaminen vie noin 5-10 minuuttia ja vastaamisen voi keskeyttää koska tahansa.

Kyselyyn vastaaminen ei sido sinua mihinkään eivätkä vastauksesi vaikuta millään tavalla opintoihisi.

1. Haluan osallistua tutkimukseen ja hyväksyn antamieni tietojen käsittelyn.

◯ Kyllä

◯ Ei

2. Haluan lukea tietosuojaselosteen?

◯ Kyllä

◯ Ei

3. Pääaine *

◯ Fysiikka

◯ Kemia

◯ Biologia

◯ Maantiede

◯ Matematiikka

◯ Muu, mikä? _____

Seuraavaksi sinulle esitetään väitteitä liittyen mahdolliseen päätökseesi hakeutua opiskelemaan

opettajaksi.

4. Oletko ajatellut hakevasi aineenopettajan opintoihin opintojesi aikana? *

◯ Kyllä

◯ Mahdollisesti

◯ Ei

◯ En tiedä

5. Kerro lyhyesti tärkeimmät syyt siihen, miksi mahdollisesti haluaisit tai et haluaisi opettajaksi. *

_____
_____
_____
_____
_____

Kuvittele itsesi tilanteeseen, jossa haluat hakea opettajan opintoihin.
Missä määrin alla mainitut tekijät vaikuttaisivat päätökseesi hakeutua opiskelemaan opettajaksi?
Valitse sinua parhaiten kuvaava vaihtoehto käyttäen asteikkoa 1-7.

1 = Merkityksetön
2 = Lähes merkityksetön
3 = Melko merkityksetön
4 = Siltä väliltä
5 = Melko tärkeä
6 = Tärkeä
7 = Erittäin tärkeä

Hakisin opettajan opintoihin, koska...

6. olen kiinnostunut opettamisesta. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

7. ystävieni mielestä minusta pitäisi tulla opettaja. *

	1	2	3	4	5	6	7

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

8. opettajana minulla tulisi olemaan pitkähköt lomat. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

9. minulla on hyvän opettajan ominaisuudet. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

10. opetustyössä voisin maksaa takaisin yhteiskunnalle. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

11. olen aina halunnut opettajaksi. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

12. opetustyössä voisin muokata lasten/nuorten arvoja *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

13. olen epävarma siitä, mille uralle haluaisin. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

14. pidän opettamisesta *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

15. haluan työn, jossa toimitaan lasten/nuorten parissa. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

16. opetusalalla työpaikka olisi varma. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

17. opettajan työaika sopii yhteen perheellisen velvoitteiden kanssa. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

18. minulla on ollut inspiroivia opettajia. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

19. minulla on hyvät opetustaidot. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

20. opettajien yhteiskunnallinen panos on merkittävä. *

1	2	3	4	5	6	7

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

21. opetustyössä voin vaikuttaa seuraavaan sukupolveen. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

22. perheeni mielestä minusta pitäisi tulla opettaja. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

23. haluan työskennellä ympäristössä, jossa lapset/nuoret ovat keskiössä. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

24. opetustyö tarjoaa luotettavat ansiotulot. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

25. opettajan työn lomat sopii yhteen perhesitoumusten kanssa. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

26. minulla on ollut hyviä opettajia roolimalleina *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

27. opetustyössä voin palvella yhteiskuntaa. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

28. opetustyössä voin saada heikommassa asemassa olevat lapset/nuoret asettamaan tavoitteensa korkeammalle. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

29. pidän työskentelystä lasten/nuorten parissa. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

30. opetustyö tarjoaa vakaan urapolun. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

31. minulla on ollut myönteisiä oppimiskokemuksia. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

32. niiden mielestä, joiden kanssa olen työskennellyt, minusta pitäisi tulla opettaja. *

	1	2	3	4	5	6	7	
Merkityksetön	○	○	○	○	○	○	○	Erittäin tärkeä

33. opettajan ura sopii kykyihini. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

34. valitsisin opetustyön viimeisenä uravaihtoehtona. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

35. opetustyössä voin olla hyödyksi sosiaalisesti heikommassa asemassa oleville. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

36. opettajan työssä saan mahdollisuuden vaikuttaa lapsiin/nuoriin. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

37. opetustyössä saan mahdollisuuden työskennellä sosiaalista epätasa-arvoa vastaan. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

38. haluan auttaa lapsia ja nuoria oppimaan. *

	1	2	3	4	5	6	7	
Merkityksetön	◯	◯	◯	◯	◯	◯	◯	Erittäin tärkeä

Arvioi, missä määrin seuraavat kysymykset pitäisivät omalta osaltasi paikkansa.
Valitse paras vaihtoehto käyttäen asteikkoa 1-7, jossa 1 = "Ei lainkaan" ja 7 = "Mitä suurimmassa määrin"

39. Onko opettajilla mielestäsi raskas työtaakka? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

40. Onko opetustyö mielestäsi emotionaalisesti vaativaa? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

41. Onko opettaminen mielestäsi kovaa työtä? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

42. Vaatiiko opetustyö mielestäsi paljon asiantuntijatietoa? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

43. Tarvitsevatko opettajat mielestäsi paljon teknistä tietoa? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

44. Nähdäänkö opettajat mielestäsi ammattilaisina? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

45. Nähdäänkö opetustyö mielestäsi korkean statuksen ammattina? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

46. Onko opettaminen mielestäsi urana arvostettu? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

47. Tuntevatko opettajat mielestäsi olevansa yhteiskunnan arvostamia? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

48. Tuntevatko opettajat mielestäsi ammattinsa sosiaalisen statuksen korkeaksi? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

49. Onko opetustyö mielestäsi hyvin palkattua? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

50. Saavatko opettajat mielestäsi hyvää palkkaa? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

51. Onko sinua kannustettu ryhtymään opetusalalle? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

52. Onko sinulle sanottu, ettei opettaminen olisi hyvä uravalinta? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

53. Ovatko toiset saaneet sinut harkitsemaan opettajan uraa? *

	1	2	3	4	5	6	7	
Ei lainkaan	◯	◯	◯	◯	◯	◯	◯	Mitä suurimmassa määrin

Appendix 2 Interview invitation

Dear Teacher- Student,

My name is Romy Valo, and I am a master's degree student at the University of Turku. In the context of my master's thesis, I aim to explore possible reasons for the declining numbers of teachers in the important science subjects.

Recently there have been concerns about the decreased number of Finnish subject teachers in mathematics, physics, and chemistry in the recent years (https://yle.fi/uutiset/3-12231533). In order to gain understanding about the potential reasons behind this decline I aim to interview:

> **Finnish teacher-students with a main or side subject in mathematics and natural sciences**
> (luonnontieteet ja matematiikka) who are in or have already completed their pedagogical training.

From this group, I would like to interview both: students that are sure they want to become science teachers in school and students that aren't sure they will continue on that path.

So, if you belong to any of these categories I would **highly appreciate it if you could participate in my research**!

The aim of these interviews is to gain better understanding about:

> The reasons science students choose to pursue teacher education.
> The effects the pedagogical training has on student's career choices.
> The reasons why science students who complete a teacher training program decide to enter or not to enter the teaching profession.

Through the interviews, I hope to inform further research and policy related to the impending teacher shortage in science subjects in Finland.

The duration of **the interview is estimated at ca. 30 minutes with a maximum of 1 hour**. The interview can be scheduled according to your preferences **in person or using Zoom**. **The interview is held in English**. If you agree to participate in the interview, I will make a recording for the purpose of transcribing before analyzing the interviews. The recordings will be stored securely on the protected university server (seafile) and only I and my thesis supervisor will have access to the recordings. In the transcription process the interview will be pseudonymized and only these pseudonymized transcripts will be used for the thesis and the recordings will be deleted after this process is finalized. Quotes from the transcript will only be used in the thesis if you provide explicit consent. Please be assured that the data is used only in the context of this research or publication purposes (if you agree to it). However, before anything is published, I will send you a piece of my writing.

If you like to participate in the interview, **please reply to this email address** (romy.r.blase@utu.fi) and I will send you a Doodle link through which you can select a time for the interview that suits you (if none of the options suits, we can agree upon another time).

Should you have any further questions, please do not hesitate to contact me.
Kind regards
Romy Valo

Appendix 3 Privacy notice

Privacy notice

1. Name of the register:
Why (not) to become a science teacher in Finland?

2. Data Controller:
Romy Valo, romy.r.blase@utu.fi

3. Contact information of the responsible person and the Data Protection Officer:
Romy Valo, romy.r.blase@utu.fi

4. Purpose and legal basis for the processing of personal data:
The research collects subject students' and subject teacher students' views and experiences on becoming a science teacher. Email addresses are used when sending out invitations, agreeing on the interviews and for a confirmation of the interview analysis to ensure the validity of the research. The interviews involve collecting information on the students' experiences and views on e.g. student career choices, making decisions about studies and professional path, structure of their studies, and future plans. Interview recordings contain the voice and in case of Zoom recordings also the image of the interviewee.

The legal basis for processing personal data in the Article 6 of the EU General Data Protection Regulation is:

☐ Processing is necessary for scientific research (public interest, Point 1a of the Article 6)

☒ Data subject has given their consent to processing personal data (consent, Point 1e of the Article 6)

☐ Other, what_____

5. Processed personal data:
The following information of the data subjects is stored in the register:
Email address (voluntary); Recording: voice, voice & image; Recording and transcription: Why (not) to become a science teacher in Finland?

6. Recipients and recipient groups of personal data:
The data will not be transferred or disclosed to parties outside the research group.

7. Information on transferring data to third countries:

Personal data will not be disclosed to parties outside the EU or the European Economic Area.

8. Retention period of personal data or criteria for its determination:

The interviews will be stored until the end of the study for a maximum of 5 years, personal data collected will be disposed of securely. Recordings will be transcribed, and the interviews will be pseudonymised with respect to direct and indirect personal data during the transcription process. These transcripts will be the data for the research. The transcripts will be stored for a maximum of 5 years. Recordings will be kept as proof for the consent and will be deleted upon completion of the research. E-mail addresses will be deleted after the interview, unless agreed otherwise during the interview.

9. Rights of the data subject:

The data subject has the right to access their personal data retained by the Data Controller, the right to rectification or erasure of data, and the right to restrict or object the processing of data. The right to erasure is not applied in scientific or historic research purposes in so far as the right to erasure is likely to render impossible or seriously impair the achievement of the objectives of that processing.

The realisation of the right to erasure is assessed on a case-by-case basis.

The data subject has the right to lodge a complaint with the supervisory authority.

10. Information on the source of personal data:

In order to invite participants to take part in the survey, contact will be made with university staff in order to share the survey with their classes. The other data is collected directly from those who participate in the survey for the study.

11. Information on the existence of automatic decision-making, including profiling:

The data will not be used for automatic decision-making or profiling.

Appendix 4 Interview guide

Adapted from an interview protocol of Rots et al. (2012)

1. Consent

1. Do you consent to the recording of this interview?

2. Do you further consent that the interview will be transcribed and pseudonymized by me and that the transcript will be used as a basis for further data analysis?

3. Moreover, do you consent to quotes from this interview being used in my master's thesis and possible research publications? Alternatively, I can first inform you about quotes I would take from the transcript before submitting my master's thesis and you can agree again to the usage.

2. Interview themes and questions

Themes	**Questions** and possible follow-up questions
1. Study Background	• **What do you study?** - What subject(s) do you study? • **Could you describe your study path?** - Are you currently enrolled in a teacher training program, or have you already finished the teacher training? - When did you choose and apply for the teaching track? (First or second line of studies) - Is the teaching profession your first career choice or have you pursued another profession before?
2. Exploring possible shifts in the career choice motivation before enrolling to teacher education	*In a survey, first-year students in the natural sciences and mathematics were asked whether they could imagine becoming a teacher. Some students answered that they were already sure they wanted to become a subject teacher, others were not yet sure whether they wanted to become a subject teacher and others completely refused to become a teacher.* • **When you think back to when you started your own studies, which of these three groups would you place yourself in and why?** • **Has your wish to become a teacher changed after the start of your subject studies or after the admission to teacher training?**
Exploring motives for enrolling in teacher education	• **How did you decide to enter the teacher education programme?** (Rots et al., 2012) • **What were your motives for choosing the teacher education programme?** (Rots et al., 2012) • **When you started the teacher education, how sure were you that you wanted to be a teacher?**

Themes	**Questions** and possible follow-up questions
Exploring possible critical incidents, phases, and persons during the teacher education	*When you think of your teacher training* • **What were the most important people, experiences or events that contributed to your wish to become a teacher?** (Rots et al., 2012) • **Looking back to your practice phases, what were the highlights?** (Rots et al., 2012) - What were the disappointments or the setbacks you faced? (Rots et al., 2012) - How did you overcome these challenges? (Rots et al., 2012) • **Can you describe your relationship with the teacher educators of the teacher training school** (with your supervising teachers, with pupils, with other actors in the school)? (Rots et al., 2012)
Self-image	• **If you were limited to five adjectives to describe yourself as a teacher, what five would you choose and why?** (Rots et al., 2012)
Task-perception and subjective educational theory	• **What characteristics are in your opinion crucial for being a good teacher in science or mathematics subjects?** (Rots et al., 2012) - How have these characteristics been addressed in the teacher education, or in your studies in general (both the subject and teacher education)?
Self-esteem	• **Being completely honest, do you consider yourself a good teacher?** (Rots et al., 2012) - What are your strengths/weaknesses? (Rots et al., 2012)
Job motivation	• **What are the most pleasant/unpleasant aspects of the teaching profession?** (Rots et al., 2012)
Exploring future perspective (career plans) in student teacher's professional self-understanding	• **What do you think will your first job be after graduation?** (Rots et al., 2012) - How come (not) the teaching profession? (Rots et al., 2012) - *If there is a change in career choice motivation: What are the most critical factors for you for changing your wish to become a teacher?*
Possible suggestions for changes in teacher education/ profession	*I told you earlier about our survey of first-year science students, in which 3 student groups could be distinguished based on their career aspirations. Some students were certain that they wanted to become science or math teachers one day. Other students were certain they never wanted to be teachers. In addition, there was a third group of students who were not yet sure if they wanted to be teachers one day.* • **If you think of yourself and your fellow students, is there something that could be changed to attract students who might be unsure whether they want to pursue the teacher training track and a career as a science or mathematics teacher?**

Appendix 5 Coding scheme

Name	Definition	Location in the interview of categories/ Example items
1. Changes in career choice decisions to become a teacher	**Reported changes in students' career aspirations to become teachers during academic or pedagogical education**	**2. Exploring possible shifts in the career aspiration before enrolling to teacher education; 9. Exploring future perspectives**
1.1 maintaining high job motivation	The teacher student reports that their desire to become a teacher has remained the same or even increased over the course of their education.	"So, I have known quite a while and when I came to university, I knew that I want to become a teacher and that has stayed stuck to me all these years."
1.2 from high job motivation to uncertainty	The teacher student reports that their career aspirations to become a teacher was certain at the beginning of their subject studies and shifted over the course of their education to feeling uncertain to become a teacher of science and mathematics	"So, it's kind of pushing me away because I'm not like prepared to go there [to the chemistry teacher job] even though I should be and it's like made me think that: "Do I want to be a chemistry teacher?" I know that I want to be a teacher but is chemistry the [right] thing?"
1.3 other change - change in the choice of school type	The teacher student reports a change in their choice of school type	"For me when I came to study mathematics it was my idea that I'm going to teach advanced mathematics in upper secondary school. That was for me like the idea at the beginning. But now after the [pedagogical] training, where I also had the chance to more get to know the upper school, I'm also open to it."
1.4 uncertainty to high job motivation	The teacher students reports that their career aspirations to become a teacher were uncertain at the beginning of their subject studies and shifted over the course of their education to a desire to become a teacher	"Yes, I had an idea that I wanted to be a teacher, but I was not 100% sure. After the presentation I was 100% sure that I would like to be a teacher."
2. Critical persons, incidents, or phases during teacher education	**The teacher student reports about critical individuals, incidents, or phases during teacher education that contributed to the wish to become a teacher or motivational change**	**4. Exploring possible critical incidents, phases and persons during the teacher training**

Name	Definition	Location in the interview of categories/ Example items
2.1 Critical incidents	The teacher student reports about critical incidents during teacher education that contributed to the wish to become a teacher or motivational change	-
2.2 Critical persons	The teacher student reports about critical persons during teacher education who contributed to the wish to become a teacher or motivational change	"Yeah, she was really helpful. She [the supervising teacher] was the best, I would say."
2.3 Critical phases	The teacher student reports about critical phases during teacher education that contributed to the wish to become a teacher or motivational change	-
2.4 Experiencing professional growth	The teacher student reports about experiencing professional growth during teacher education that contributed to the wish to become a teacher or motivational change	"Of course, the teaching experience is one huge influence, that made me even more sure that this [teaching] is what I want to do. Just to be able to teach."
3. Motives or reasons to become a teacher	**Motives or reasons to which the student attributes his/her desire to become a teacher.**	**3. Exploring reasons for the entrance in the teacher education**
3.1 Motives to work as a science subject teacher	**Motives for wanting to work as a teacher in the future (aspects of the teaching profession)**	
3.1.1 Lack of subject teachers in science and mathematics	The teacher student reports that the lack of subject teachers in science and mathematics and hence, good career chances contributed to their wish to become a teacher	"But I was like very interested in every subject, but then I have to decide what would I be teaching in the future. So, I kind of [checked] for what subject group is there most jobs available."
3.1.2 Practical aspects of the teaching profession	The teacher student reports that the practical aspects of the job of a subject teacher contributed to their wish to become a teacher	"First thing that came to my mind is like the working hours with summer holiday and that stuff."
3.1.3 Social or societal aspect of the teaching profession	The teacher student reports that the social or societal aspects of the job of a subject teacher contributed to their wish to become a teacher	"Also, I like actually to stay at home and be alone a lot but because I do that, I like need to be very social in the work life, so there would be a balance then. And I kind of knew that teacher would be doing that [be social]."
3.1.4 Wish to teach	The teacher student reports that the wish to teach contributed to their wish to become a teacher	"My main reasons for wanting to get into teacher studies? Well, because I want to become a teacher obviously."

Name	Definition	Location in the interview of categories/ Example items
3.1.5 Work environment	The teacher student reports that the work environmental aspects of the job of a subject teacher contributed to their wish to become a teacher	"Teachers in general, I think they are quite active people in the society, so they are good people to be to be around with and have as colleagues. They all [the other teachers] I think share the idea of wanting to be there for the young people. So, it's good mindsets or good value to have as a field."
3.2 Reasons to choose the teaching profession	**Retrospective reasons for choosing the teaching profession (based on events/ experiences/ other causes from the past of the individual)**	**3. Exploring reasons for the entrance in the teacher education**
3.2.1 Comparison with other career opportunities	The teacher student reports weighing other career options and concluding that teaching is the best career choice	"Then I was like thinking that I kind of thought that I would not be suitable in like the company life of the business life. I didn't think that I would be good there, because like money has never been any sort of motivation for me. So, it's kind of like not there."
3.2.2 Familiarity of the profession	The teacher student reports that they wanted to become a teacher as the profession and the work surrounding at school are familiar to them.	"It was about the school because I've like been to school like for so many years, I know how the routine goes the week and it's like in the school life you can like plan ahead very easily, because you know what is coming."
3.2.3 Prior teaching experiences	The teacher student reports that experiences in subject teaching or other teaching experiences contributed to their desire to become teachers (note: student has to make the connection between prior experience and its contribution to the wish to become a teacher)	"I think I have always liked teaching, like other people my age and younger siblings and other relatives."
3.2.4 Role models	The teacher student reports that the observation of role models has contributed to their wish to become teachers.	"But of course, I had some good role models. I thought that I have some very good math teachers."
3.2.5 Supportive persons	The teacher student reports that important people have encouraged them to become teachers or have believed in their teaching abilities.	"…pretty much everyone said that you should become a teacher that you are so good at teaching, so yeah."