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RELATIONSHIP BETWEEN STUDENTS' STEM INTERESTS AND FUTURE CAREER ASPIRATIONS

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Relationship between students' STEM interests and future career aspirations
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Abstract:

Despite the crucial role of STEM professionals in the economic and technological development of nations, including Finland, there is a lack of student motivation to pursue STEM-related careers. To address this issue, this study investigates the factors contributing to compulsory basic school students' career aspirations in STEM fields, with emphasis on understanding different groups of students based on their STEM career aspirations, preferred information sources, and perceived characteristics of future professions. The data for this study was collected from 1454 grade 8 students, aged 14 to 15 years old, who are enrolled in Finland's nine-year primary and secondary compulsory basic education. A Likert scale questionnaire was used to gather the data, and analysis included mean, standard deviation, cluster analysis, and Kruskal-Wallis test. The findings revealed that students were divided into three types of STEM career interests (No STEM, medical STEM, and general STEM). Moreover, workplace visits and TET practices were the most preferred sources of information for students in both STEM career aspiration groups, while counselling outside school was the least preferred. The study's findings also show that medical STEM students prefer jobs that involve working with and assisting people, whereas general STEM students prefer jobs that promote technological development. The study emphasizes the importance of educating teachers and guidance counsellors about STEM careers, incorporating students' interests into STEM curricula, and developing effective interventions for future careers in STEM.

Keywords: STEM, STEM career aspiration, interests

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1 Introduction

Qualified people in the fields of STEM (science, technology, engineering, and mathematics) are crucial to a country's economic and technical development in the new global economy (Carnevale et al., 2011; Maksimović et al., 2020). STEM education plays important role in addressing the issue of attracting students into STEM fields because it helps them to develop soft skills, comprehensive skills, and 21st-century skills, and therefore, should be integrated into the actualization of educational learning (Siregar & Rosli, 2021). Considering these, the European Commission estimates that the demand for high-skilled STEM jobs will rise across Europe by 2025 (Shapiro et al., 2020).

However, with respect to the importance of STEM education and careers in the fields of STEM, there has been relative shortage in these subject fields and the lack of student motivation in this area, which has been reported in several countries, which includes Finland as well (OECD, 2019). The Low motivation of student interest in STEM fields in the Finnish education system has raised considerable concern among policy makers, STEM professionals, and science programs in the nation (Salmela-Aro, 2020). Additionally, the study has shown that this low motivation has resulted in Finnish students having the lowest likelihood among other OECD countries to working in science-oriented careers at the age of 30 (Salmela-Aro, 2020).

Therefore, it is essential to find methods to increase the number of students pursuing STEM related careers (Kwon et al., 2019), positioning them as technological world powers which has the possibility of progressing them socially (Hossain & G Robinson, 2012). This is particularly relevant when choosing a profession, as it is one of the most important and difficult decisions faced, determining an individual's career trajectory and future success are heavily reliant on this decision (Maksimović et al., 2020). Central to the case of students, the decision

and motivation to plan a career is mostly decided at the final year in high school (Srianturi & Supriatna, 2020).

Al-Bahrani et al. (2020) note, however, that many elementary school students' personal important professional traits are still in their foundation stage, making it challenging for them to identify their inclinations, abilities, and aspirations when deciding on future careers. In addition, the challenge is further compounded by their lack of exposure to a variety of career options and their belief that some professions are gender specific. Students in the eighth grade, for instance, tend to agree on whether a particular occupation is more inclined to employ men or women (Ji et al., 2004), that contributes to their interest in classes, leading to a specific profession. What inspires a student to learn is a significant factor when choosing a professional path; students who find subjects they are passionate about during their compulsory school years have a greater chance of having sufficient preparation for careers in areas connected with those passions, resulting in greater job satisfaction and a more beneficial job search (Harackiewicz et al., 2016).

Kaleva et al., (2019) discovered that students' passions, aptitudes, and objectives for their subsequent studies and professions had the greatest impact on their subject matter selection and refusal decisions. The researcher further emphasized that these factors were the most important factors to investigate, as they have a significant impact on students' future STEM pursuits and are vital when considering a career.

Another important discovery is that lack of passion in STEM careers is sometimes the result of the difficult nature of mathematics and science subject fields. Additionally, Nariman & Davis (2021) reported that several students that are passionate about STEM subjects lack the skills necessary to excel in the hard science and mathematics courses required for STEM

disciplines. As a result, students who are inadequately prepared frequently lose desire in and enthusiasm for careers in STEM. Many students who are interested in STEM careers are inadequate for success in the rigorous coursework, which reduces their enthusiasm and fascination for these fields. In other words, many students who are interested in STEM fields are ill-prepared to succeed in the difficult coursework, which reduces their curiosity and enjoyment of STEM careers. This, in turn, benefits not just their professional pursuits interests, but also their prospective career choices and their desire to pursue a STEM (science, technology, engineering, and mathematics) profession (Blotnicky et al., (2018). It is also essential to keep in mind that social factors may have an impact (Han et al., 2018; Li et al., 2021) on people's understanding about STEM occupations and career choices. The effects of society can be felt in many ways, such as the advice of teachers, role models, parent's role, the knowledge gained from job fairs and professional information, and even the insights acquired from peers. Most research has been done on the disparities between gender differences and its influence on students choosing STEM career (de las Cuevas et al., 2022; Ertl et al., 2017; Franz-Odendaal et al., 2020; Kaleva et al., 2019; Kang et al., 2019; Makarova et al., 2019; Tyler-Wood et al., n.d.), association on mathematics self-efficacy and its role in students choosing a STEM career (Blotnicky et al., 2018; Franz-Odendaal et al., 2020; Kaleva et al., 2019; Kwon et al., 2019), and also teachers role in fostering students' interest in STEM field (Margot & Kettler, 2019). This study investigates the factors contributing to compulsory basic school students' career aspirations in STEM fields, with a particular emphasis on understanding different groups of students based on their career aspirations, preferred information sources, and perceived characteristics of future professions. Gaining insights into these choices in relation to students' STEM career aspirations is crucial for helping them understand their goals and make informed career decisions as adults.

2 Theoretical Framework

This study will use the theoretical framework of Eccles' Expectancy-Value Model (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000) . This theory offers a comprehensive framework for understanding how students make decisions about their educational and future career paths in STEM. This theory further proposes that the expectation of success of students in an academic field and the value being placed on the field in the context of their future career aspiration plays an important role in their choices (Wiebe et al., 2018).

According to expectancy-value theory, people's decisions about majors in college, career paths, and even course selection in high school are heavily influenced by their expectations for their own abilities and the importance they place on a given activity. In other words, people's levels of enthusiasm and involvement in any given domain are determined by their subjective beliefs about their own talents in that domain, as well as their beliefs and feelings about the domain itself (Wigfield & Eccles, 2000). For example, if a student has confidence in doing well in mathematical and scientific abilities and sees engineering as a prestigious and rewarding profession, the student is more likely to be highly motivated to pursue a career in this field. However, a student's interest in engineering may diminish if they feel unqualified for engineering careers and have low self-esteem in mathematics and science.

Similarly, Wang et al., (2013) supports this view that individuals' choice of a college major or professional path is an example of an achievement-related decision that may be explained by expectancy-value theory. Also, self-schema, objectives, and developing an identity are all examples of structures and processes that this framework highlights as being dynamic and subject to change over time because of exposure to new knowledge and personal growth.(J. Eccles, 2011). Individuals' hopes for success and their own evaluations of the importance of a

given activity are two key components of the achievement-related decision (Leaper, 2011; Van den Broeck et al., 2014). Furthermore, these achievement choices of individual can both be impacted by positive and negative characteristics of the task, and that every choice has associated costs since selecting one option usually excludes others (Meece et al., 1990). Therefore, the importance and likelihood of success of each option are crucial factors that determine the choice. Along the same line, Smit et al. (2020) argues that students' achievement-related decisions may be explained by the value they place on a given activity, as well as their level of skill and confidence in its completion (Figure 1).

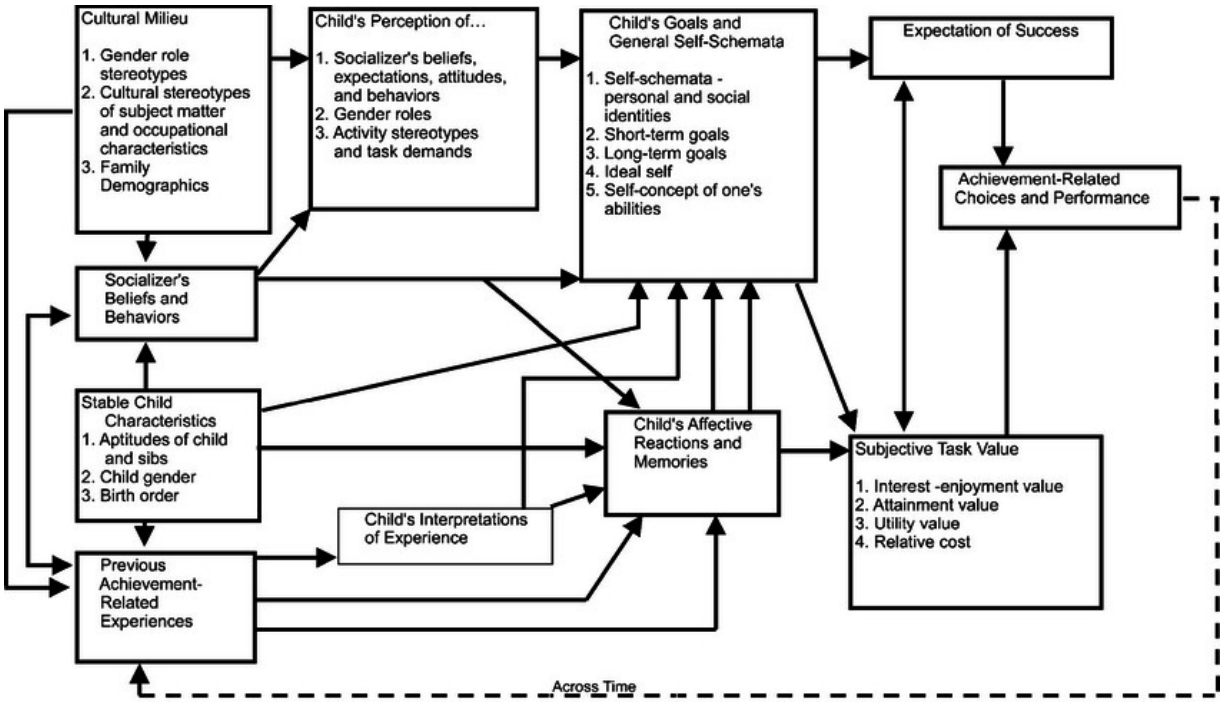

Figure 1The Eccles et al. expectancy-value model of achievement. Adapted from "Motivational Beliefs, Values, and Goals" by J. S. Eccles and A. Wigfield, Annual Review of Psychology, 53(1), 109–132. Copyright 2002. Permission to use granted by Copyright Clearance Center, Inc.

2.1 Self-concept and Task Value

According to Eccles (Parsons) et al. (1983) expectancies are swayed by a persons' self-concept, which consists of their "set of views or reference points" about themselves, including their "set of features, traits, qualities and problems, abilities and boundaries, values, and interpersonal interactions that someone knows to be describing of himself and he views as information concerning his identity" (Marsh & Yeung, 1997)**.** For example, one's belief in being very good at mathematics (Murphy et al., 2019).

Whereas task value addresses the issue "Why should I do this task?" and looking at one's own values are reflected in the tasks they choose to do (*Eccles (Parsons) et al. 1983*, n.d.; Schunk et al., 2012).

2.2 STEM Interest

STEM interest is defined by Grimalt-Álvaro et al., (2022) as student's genuine enthusiasm for, and taking part in, STEM subjects and activities. They further explained the concept of STEM interest by suggesting that the value of the task and the student's hopes for its conclusion are linked to the student's desire to continue working on it. For instance, students who anticipate being financially successful in their chosen profession are more inclined to be enthusiastic about and committed to studying and working in that field (Grimalt-Álvaro et al., 2022). Similarly, it is possible to fathom students' passion for STEM by considering their mastery of the relevant subjects. for example, students are more inclined to seek careers in those fields if they think they can be successful in them and if that they place significant importance on the benefits, such as a pleasant work environment and the flexibility to organize their time as they see fit (Akosah-Twumasi et al., 2018).

Furthermore, a significant study and discussion about interest in STEM fields carried out by Tai et al. (2006) showed that eighth graders who developed an interest in STEM career paths were three times more probable to obtain degrees from STEM-related professions than their non-interested others, and the achievement of eighth graders in mathematics was more predicting of a physical science their level path compared to biological sciences. In contrast to the earlier view, students that doubt they have what it takes to thrive in STEM fields may be less enthusiastic about pursuing professions in such areas. Psychological factors, such as one's confidence in one's own abilities and the likelihood of one's own accomplishments, and the personal task values that one attaches to achieving various outcomes were linked by Eccles et al. (1998) to educational and other achievement-related choices. And there are also personal elements like a person's past accomplishment, sex, and family's socioeconomic status, as well as social factors like the attitudes and actions of influential socializers like parents, teachers, and peers.

2.3 STEM Career Aspirations

STEM career aspiration refers to students' who have an interest in pursuing a career in the STEM areas (Science, Technology, Engineering, and Mathematics) (Grimalt-Álvaro et al., 2022). (Wang et al., 2017) further explained that students' interests, values, and past experiences may play a role in shaping their STEM career aspirations. Individuals' goals in the STEM field seems to be driven by some certain traits:

- Personal interests and Values: Students with a vested interest in a certain area of STEM study may be more motivated to major in that area in college and afterwards. For instance, students whose interests lie in biology may be motivated to pursue professions in the marine field because of their fondness for animals. Similarly, students whose interests lie in biology may also be inspired to pursue careers in the medical industry

because of their desire to interact with people and aid those in need (Wang et al., 2017). Likewise, students' values regarding their lifestyle and preference for a particular career that is related to their beliefs for instance, family-oriented careers and careers that balance work-life plays a role in students STEM career aspirations (Wang et al., 2017).

- Experiences: Students' interests in STEM fields may be formed by their experiences both in and out of the classroom. Students who have had successful experiences in STEM courses and extracurricular activities, for instance, may be more motivated to enter the STEM workforce (Hazari et al., 2010). Also, Betz & Hackett (2006) found that individual preferences, self-efficacy demands, and desired outcomes in a particular field of behaviour are three key perceptions associated with career choices.

Key attitudes associated to career desire in STEM have been identified by researchers as students' curiosity, result expectations, and self-efficacy expectations in STEM (science, technology (Betz & Hackett, 2006). For example, aspiring medical students are more likely to identify with STEM and develop a strong STEM identity if they attributed medical career to be prestigious and rewarding in nature and see fields of medicine as a STEM field that requires extensive scientific knowledge and critical thinking skills (Hazari et al., 2010).

2.4 Information Acquisition of STEM Careers

Lent et al. (1994) defined as contextual variables as "factors that (a) shape the educational experience that has impact on students' individual interests and choices and (b) form a real-world framework within which professional plans are established and implemented," encompass a wide range of influences on students' final decisions. Students' high school career goals and ambitions are influenced by a variety of contextual factors, which were further categorized into four groups (i.e., teacher assistance, family elements, childhood dream occupations, academic achievement).

Regarding the factors influencing students' STEM interests, Eccles' model explains that students are highly associated by their expectations and values regarding STEM subject fields. For example, if students perceive that they can succeed in STEM subjects in this regard, high expectancy, and they also view the STEM fields as important and relevant to their goals and values this is regarded as high value, such exposed to STEM are more likely to pursue careers in such areas. Additionally, Studies have further demonstrated that students' interest in STEM fields is related to their experiences, socializing agents like families, schools, peers, and advisors (Schmidt et al., 2012), societal and community news, and the fundamental features of the STEM subjects they engage in (Li et al., 2021).

As an illustration, Roberts et al. (2018) found that students are more likely to become interested in STEM fields if they have enjoyable interactions with STEM subjects in the areas of engaging in activities that are hands on, interaction with applications that involves practical, also receive encouragement and backing from their peers, parents, and educators, and equally views STEM careers as highly regarded and rewarding. In the same vein, Hargrove et al. (2005) found that career decision-making self-efficacy are the ability to make realistic choices, formation of career choice using occupational information and family-supported goals emphasizing intellectual/cultural pursuits were related. Bennett (2007) also reported that connections are made from the instructions students gain from adults and this helps the students to gain access to education, direction from adults, encouragement in studies and supportive relationships, which are beneficial for academic pursuit. All these are possible through the connection of adults and therefore make it impossible to exaggerate the value of family in shaping young people's job goals and ambitions. DeWitt & Archer (2015) for instance, further discovered that parents exhibit these connections significantly in encouraging their children's interest in science. DeWitt

& Archer, (2015) further found that students whose parents worked in scientific fields or held science degrees were likely to succeed in science and have strong science goals than their peers, and Chakraverty & Tai (2013) supported the view that kids whose parents encouraged them to learn about science were more likely to have a positive outlook on their own ability to learn and succeed in the subject. In addition, young children's interest in STEM fields is also affected by this. For instance, if a kid sees his dad using all kinds of cool electronic stuff, the kid could be inspired to get into technology field when they grow up (Abe & Chikoko, 2020). Likewise, Workman (2015) affirmed the view maintaining that students' families had the greatest impact on how they made major life choices.

Furthermore, studies have shown that being exposed to or familiarity with a parent's career might spark interest and enthusiasm in the same path in their children (Chakraverty & Tai, 2013). Studies have also reported the involvement of parents in the educational experiences of students, for instance, Wang & Degol, (2013) reported that parents with higher levels of education are more likely to expose their children with enriching educational experiences which in turn can be beneficial on the child's sense of identity and formation of career goals. Additionally, this high level of parental education has been identified as been connected to students' high level of interests in taking mathematics and physics classes (Simpkins et al., 2006). The author also highlights the relevance of educated parents in shaping children's scientific views, engagement in science tasks, and academic accomplishment in science, all of which point to the possibility of future pursuit of STEM careers. This highlights the value of parents as informational resources for their children by providing positive role models, extracurricular opportunities, and encouragement for STEM-related interests and goals. Gushue & Whitson (2006) also reported that parental support and teachers support plays a vital role in

students' self-efficacy in relation to choosing a career and the outcome expected from venturing into this career in future.

Masson et al. (2016) emphasized the importance of students' exposure to authentic science, such as a laboratory visits, in offering prospects for future employment and enhancing their interest in STEM fields. In addition, research conducted by Simpkins et al. (2006) revealed that fifth graders who took part in these extracurricular activities had a more positive perception of themselves and their talents by the time they reached their sixth and tenth grades. Museum trips and after-school programmes (such scientific clubs, camps, and mathematics contests) are examples of the kind of structured experiences outside of the classroom that spark kids' curiosity and enthusiasm, as elaborated by Dabney et al. (2012). For instances, Capobianco et al. (2015) looked at how engaging primary school children in engineering design-based scientific learning activities influenced their formation of an engineering identity. Students in elementary school who participate in standardized engineering learning activities show growth in their knowledge of engineering and problem-solving skills, as well as an increased interest in pursuing careers in the field.

Furthermore, as information inadequacies may lead to suboptimal decisions, and as changes in knowledge can impact individuals' utility function differently, information adequately plays an important role in the career development of secondary school students (Piepenburg & Fervers, 2022). Students' experiences from internships and company visits might help to fill information gaps. According to Bennett (2007), internship programmes and other forms of work-based learning provide critical support to students in high school in making future career choices, making the decisions less difficult and overwhelming. He also stated that during internship programmes, students can receive social support from their workplace supervisors and school

faculty in the form of career advice, words of encouragement, mentorship, and constructive criticism of their work. The expectancy-value theory provides more insight into the significance of information by explaining why people choose to pursue careers about which they know the most rather than those that are best suited to their talents and interests. This is view is also supported by Anjum, (2020) that students are more likely to want to pursue a certain career path if they believe they have had good experiences in that field (through internships in companies and job shadowing), if they get encouragement and assistance from their socializing agents, and if they believe the career path is prestigious and rewarding.

Schools may also help children by using counselling and guiding methods, which raise students' levels of awareness and, in turn, improve their learning (U.S. Department of Education, 2021). This may be accomplished by supporting students in preparing for STEM careers by developing informative, user-friendly tools (Schmidt et al., 2012) and career information. According to research of Murcia et al. (2020), career counsellors have a unique opportunity to deliberately incorporate STEM knowledge into the process of helping students establish their goals. In the same vein, Borghans et al. (2015) emphasised the importance of counsellors in reducing uncertainty regarding students view on their expectation of labour market, their job-specific needs and most importantly on how to understand oneself in relation to job preferences in future. Schmidt et al. (2012) also agree with this point of view, noting that during the sixth to eighth grade transition, when students select courses related to STEM in compulsory basic school, guidance counsellors who have sufficient knowledge on STEM can assist students figure out the connection between academic choices and future STEM career goals. Importance of Counselling in schools is also emphasized by Nikischer et al. (2016), who found through

observation of a school counselling session that students lacked information necessary to make informed decisions about the STEM-related courses to which they were being exposed. Understanding these choices in relation to their STEM career aspirations helps youths better understand and make better career choices as adults.

One study by Li et al. (2021), focused on the concept of early career development, and they found that 11 of the 12 participants thought that their future professional preferences are inspired by their favourite childhood jobs. Researchers also further explained that secondary school science studies set the stage for STEM studies and have an impact on the likelihood that student rejects, persist in and enter STEM fields (Engberg & Wolniak, 2010), while also encouraging students' aspirations for future studies and careers in STEM fields in higher education. Jung (2017) suggested that the expectancy-value theory puts out the concept that an individual's desire to follow a certain activity is controlled by their expectations of succeeding in that work, as well as their own values such as interest, pleasure, recognition, and money. In this regard, the research emphasizes the significance of the theory of expectancy-value in explaining how an individual's professional decisions are influenced by their expectations of future success and their core beliefs.

The Eccles' Expectancy-Value theory is a useful framework for analysing the elements that affect students' motivation to pursue degrees and careers in the STEM disciplines. By examining the model's core concepts like expectations, values, and sources for information, researchers and educators can gain a deeper understanding of how to pique students' curiosity in STEM fields and encourage them to pursue careers in these areas.

2.5 Characteristics Perceived as important for STEM Careers

Students' physical results related to their career goals can be linked to job fulfilment, job security, and a high income at work. According to Li et al. (2021)**,** the majority of respondents in his study indicated that their expectations for the outcomes of a career in STEM begin with a belief that positions in STEM fields provide excellent possibilities for rapid financial gain, which is consistent with the view that functioning in an enjoyable working environment (e.g., comfortable ambiance, freedom) and satisfying future job market demands (e.g., job safety) are two imagined implications of a STEM career path. In contrast, Wang et al. (2017) observed that individuals who regards jobs with flexible hours will unlikely venture into career related to STEM because of the view that it doesn't allow for quality time with family. Also, prior studies of Gabris & Simo (1995) found that individuals are attracted to occupations that provide all four of the following: high degrees of responsibility, hard work, high pay, and job stability. In addition to this, recent research has also shown that students value balance between work and life, intellectual stimulation, and scheduling flexibility when making career decisions (Kazzi et al., 2001) to be important factors in career selection (Celenza et al., 2012). Similarly, most recent research of Li et al. (2021) discovered that family encouragement has a significant role in shaping participants' job objectives, including their expectations of high income and a pleasant workplace.

Archer et al. (2010), who also conducted an ongoing investigation on students in elementary schools, found that presenting science classes as "carrying out scientific research" and loving working conditions instead of viewing it to become a scientist is more enjoyable for younger students. In the same vein, Smit et al. (2020) noted that children's interest and love for science appeared to be primarily designed in terms of the practical element of experiments. The

results of this study suggest that many students do scientific activities at home because they perceive it to be a pleasant and conducive place to study and complete homework. The research findings indicate that a considerable number of students engage in scientific activities outside of the classroom setting, within their domestic environment relating it to enjoying and feeling comfortable as a good working atmosphere.

Furthermore, numerous studies have emphasized the motivation of students choosing medical careers which includes a desire to help people for instance in case of career in paramedicine (Ross et al., 2016), or to serve their community as an emergency medical technician (EMTs) (Patterson et al., 2005). Newton et al. (2009) noted that some students were drawn to nursing because they expected to get high levels of personal validation and professional fulfilment because of their work in the field. Similarly, Adamson et al. (2003) also discovered that students interested in pathology and the medical radiation sciences were strongly motivated by a desire to assist others. In addition, many aspiring paramedics find inspiration in the experiences of their peers (Ross et al., 2016). Paramedic work is seen as having an exciting lifestyle, which is a draw for many people considering a career in STEM (Midgley, 2011).

3 Aims and Research Questions

The purpose of this study is to investigate the factors contributing to compulsory basic school students' career aspirations in STEM fields, with a particular emphasis on understanding different groups of students based on their career aspirations, preferred information sources, and perceived characteristics of future professions. The research will examine how career information experiences and appealing work environments play a role in shaping the aspirations of students interested in STEM careers.

The study hopes to gain insight into effective support and encouragement strategies for students pursuing STEM careers in the future through these investigations, as well as a better understanding of the factors that contribute to secondary school students' career aspirations in STEM fields, which could aid in the development of more effective strategies to encourage and support students pursuing STEM careers.

The research questions for the current research are as follows:

1. What are the different groups of students when considering their STEM career aspirations?
2. How do compulsory basic school students with STEM career aspirations like to acquire information on the different professions?
3. Which characteristics are perceived as important in the future professions among the compulsory school students with STEM career aspirations?

4 Methodology

The participants for this study were chosen from grade 8 students aged 14 to 15 years old who are enrolled in Finland's nine-year compulsory basic education. In the context of the participants, the students are from a large city in northern Finland. The dataset consisted of 1454 students, comprising 620 females (43%), 785 males (54%), and 49 students (3%) were classified as belonging to other gender categories. It is important to note that the questionnaire used in this study was developed and administered by the primary users of the data, a research unit (Kaleva et al., 2019, 2023) within the Faculty of Education in University of Oulu.

The study obtained and utilized this data with the explicit consent of the research unit. Using the Webropol online tool, the researcher collected both quantitative and qualitative data on students' subject choices, future study aspirations, and career plans. To guarantee a representative sample, the researcher distributed survey to schools in spring 2021 via principals, student counsellors, and subject teachers, and data was gathered during school class hours. Before participating, the researcher ensured that each respondent gave their consent for their responses to be utilized in this study, guaranteeing ethical data usage. The City of Oulu and the Department of Education and Culture granted permission for the study, thus establishing the necessary authorization for conducting the research and ensuring the data's reliability.

4.1 Data

The questionnaire data collected was mainly quantitative data with major themes on studying right now, continuing studies, working life and motivation of students to study. This research focuses on questions that are related to students' STEM subject interests and their STEM career aspirations. The questionnaire was presented in Likert scale question which ranged from 1= totally disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = totally agree.

To answer RQ1, what fields of study are you interested in? Participants responded to the question “Are you interested in the fields of study below?” Answer was provided from the selected fields: Fields of technology, humanities, social sectors, sciences, services, cultivation, arts and culture, business administration, information processing industries, agriculture and forestry sectors, medical sciences, health, and wellness sectors. STEM career fields were therefore categorized in this study to be Fields of technology, information processing industries, Sciences, agriculture and forestry sectors, medical sciences, health, and wellness sectors.

To answer RQ 2, participants responded to question “How would you like to get information about different professions?” The participant’s response was given in Likert scale question which ranged from 1= totally disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = totally agree. Information source about the different professions was calculated from 9 questions on the questionnaire and the questions were in the form of “By having discussions with the guidance counsellor”, “By visiting workplaces that I find particularly interesting” and “By doing TET-practices* in workplaces”.

To answer RQ 3 participants responded to question “What factors you consider important when choosing a future job?” The participant’s response was given in Likert scale question which ranged from 1= totally disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = totally agree. Information sources about the different professions was calculated from 9 questions on the questionnaire and the questions were in the form of.

The questionnaire is presented in Appendix A.

4.2 Data analysis

The quantitative data from the respondents was analysed using Statistical Package for the Social Sciences (SPSS) software (Bryman & Cramer, 2009; Gorard, 2001; Paul Connolly, 2007).

To address Research Question 1 (RQ1), two clustering techniques were used to categorize students into distinct groups based on their interests in various STEM fields. This analysis aimed to reveal patterns that could shed light on their future STEM career aspirations of the students. The hierarchical clustering method, specifically the between groups average linkage method, was employed as the first technique to determine the clusters in this study. This approach, as described by (Grimalt-Álvaro et al., 2022) for the objective identification of the underlying number of clusters without subjectivity (Atlas & Overall, 1994). It effectively detected meaningful clusters of students' interests in various STEM fields (Bruehl et al., 1999).

To gain more insightful information regarding students' STEM career aspirations, the focus was placed on the three largest clusters observed in the dendrogram. These clusters primarily consisted of students interested in subject fields such as medicine, health & wellness, information processing, technology, sciences, and agriculture & forestry. Notably, the analysis revealed that sciences + agriculture/forestry were grouped together based on their distance, and similarly, information processing + technology + sciences + agriculture & forestry were also clustered together.

Furthermore, a separate cluster emerged that combined medical, health & wellbeing, information processing, and technology. Within this cluster, medical and wellness were observed to have a smaller distance, indicating their closer association (see Figure 2). This comprehensive analysis of the clusters provides valuable insights into students' STEM career aspirations and the relationships between different subject fields.

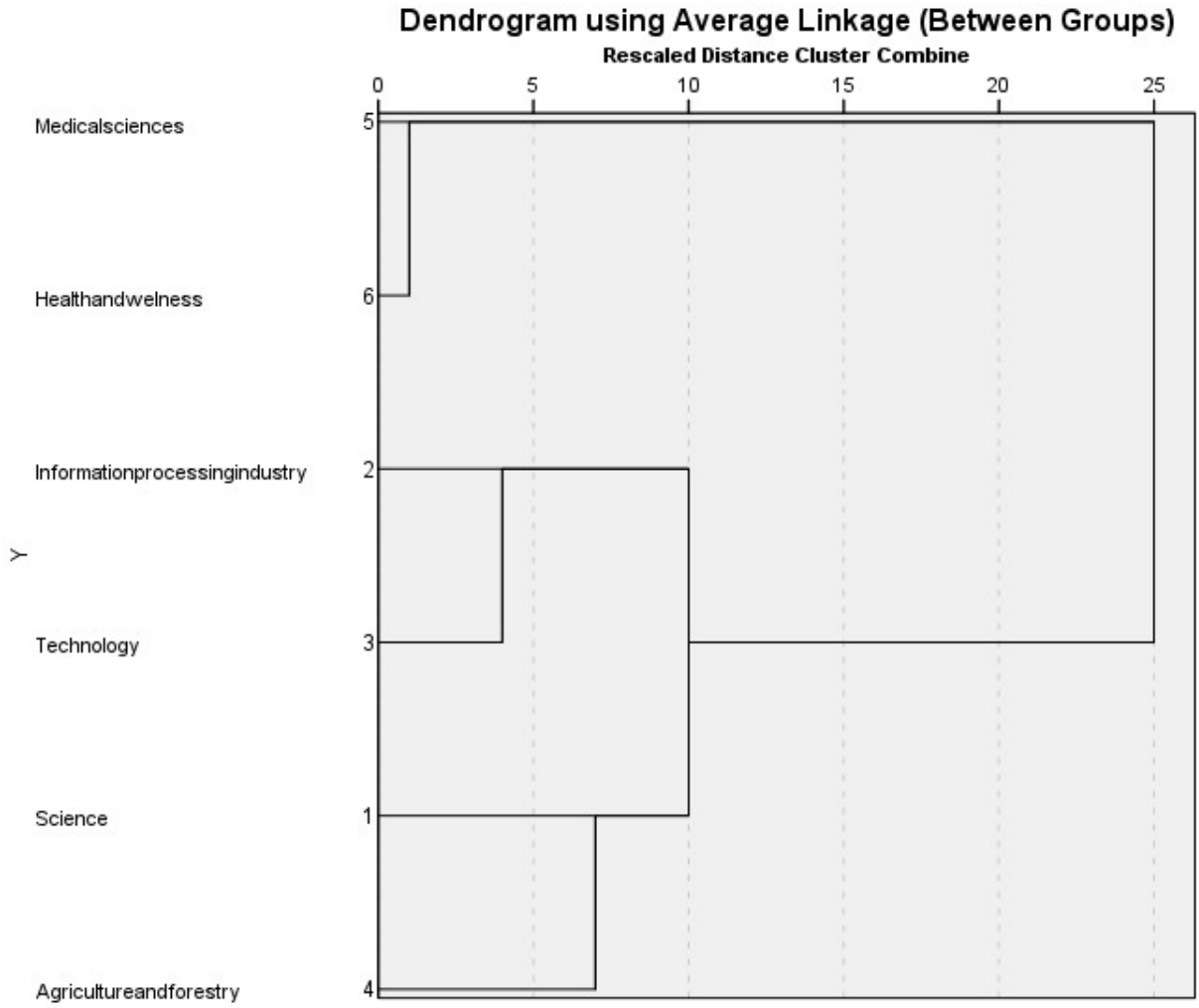

Figure 2 Dendrogram showing the clusters formation of the STEM Fields

After determining the number of clusters using the hierarchical clustering method, the second technique employed in this study to refine the cluster membership was the non-hierarchical clustering method known as k-means cluster analysis. As described by Bruehl et al. (1999), this method played a crucial role in automatically categorizing the students into different groups based on their STEM field interests. By building upon the initial cluster formation from the hierarchical clustering, the k-means analysis significantly enhanced the accuracy and precision of assigning students to their respective clusters. This analysis generated a table (see

Table 1 in the Result section) that provided a clear breakdown and categorization of the student groups based on their identified clusters.

To answer RQ2 and RQ3, descriptive statistics were used to identify differences and similarities in preferences of each group. The mean and standard deviation (SD) of each group's responses to survey questions were calculated to provide an average measure and determine the degree of response dispersion within each group. To examine whether significant differences existed between the groups for RQ3, a non-parametric test was used to determine the significance of the difference, and the Kruskal-Wallis test was utilized for comparing perceived future job characteristics of students with STEM career aspirations across groups. The test of normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests (see Appendix B) were first conducted to determine whether the data was normally distributed. The tests' significant values indicated that for perceived future profession characteristics are all less than the significant value of 0.05, indicating that the data were not normally distributed, resulting in the decision to use the Kruskal-Wallis test which do not need to assume normality (Carver & Nash, 2011). Dunn’s post hoc test was further conducted for multiple comparisons among the three groups.

5 Results

The purpose of this study is to investigate the factors that influence secondary school students' career aspirations in STEM fields. To achieve these goals, the following research questions were developed: what are the different groups of students when considering their STEM career aspirations? How do compulsory basic school students with STEM career aspirations like to acquire information on the different professions? and Which characteristics are perceived as important in the future professions among the compulsory school students with STEM career aspirations? Methodologies such as descriptive statistics, hierarchical and K-mean cluster analysis, and Kruskal-Wallis test were presented in the results.

5.1 What are the different groups of students when considering their STEM career aspirations?

In consideration of STEM-related career aspirations, the results of the cluster analysis tend to suggest that student responses reveal three distinct groups. Table 1 depicts the three groups and their interest in different STEM fields.

Group 1 demonstrated low interest, with values ranging between 1.52 and 2.20 mean, indicating that this group of students has low interest in STEM-related fields and considered as No STEM group. The group 2 showed a similar pattern as the group 1, but with relatively high mean values of 4.09 and 4.27 in medicine and health and wellness, respectively, indicating that this group is interested in the medical field and therefore tagged as the medical STEM group. Group 3, considered as the general STEM interest group, showed an average mean value across all six fields, indicating an interest in all listed STEM fields.

Also, the table displays the number of contributions made by each group in the distribution. The group with an interest in the general STEM has made the most contributions to

the cluster with 529 students. The other two groups, those with an interest in No STEM fields and those with an interest in medical STEM, each have 450 and 475 students respectively.

Table 1 Different groups of students when considering interest in STEM fields.

	Clusters (Groups)		
Fields	**No STEM (n= 450)**	**Medical STEM (n= 475)**	**General STEM (n= 529)**
Sciences	1,79	2,13	3,26
Information Processing	1,78	1,67	3,43
Technology	2,20	1,54	3,72
Agriculture & Forestry	1,82	1,55	3,10
Medicine	1,59	4,09	3,21
Health & Wellness	1,58	4,27	2,99

5.2 How do compulsory basic school students with STEM career aspirations like to acquire information on the different professions?

Table 2 presents the findings on the preferred information sources for students with STEM career aspirations for different professions. The results indicate that for students in both STEM aspirations, the most preferred way to acquire information for different professions is "by visiting workplaces that I find particularly interesting," with both the medical STEM and general STEM reporting a high mean preference of 4.4 (SD=0.9) and 4.3 (SD=0.9) respectively. Likewise, for the question "by doing TET (introduction to work life) practices in workplaces", the report was also high in both STEM groups, medical STEM reporting a mean of 4.1 and 4.0 for general STEM students. However, these differences in both information preferences among the two STEM groups were not statistically significant.

For both medical STEM and general STEM groups, career counseling is shown to be quite low. It is noteworthy that the preference for career counseling done outside of school had a relatively low mean score, with the medical STEM group scoring a mean of 2.8 and general STEM group having a mean of 3.0. Similarly, the preference for having discussions with guidance counselors was also low, with the medical STEM group scoring a mean of 3.2, slightly higher than counseling done outside of school but still low, and the general STEM group scoring a mean of 3.1, which is not significantly different from the preference for counseling done outside of school.

Furthermore, students in both the medical STEM and general STEM groups also showed moderate preferences in acquiring information regarding their STEM career aspirations. With mean preferences of 3.6 (SD=1.2) for the medical STEM group and 3.5 (SD=1.1) for the general STEM group, both groups showed a considerable interest in using online tests to determine

appropriate professions. Likewise, with a mean preference of 3.6 (SD=1.2), students with general STEM interests preferred learning about various professions through introductory videos.

Table 2 Students STEM career aspirations and information preference

	No STEM		**Medical STEM**		**General STEM**	
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
By having discussions with the guidance counsellor.	2.7	1.3	3.2	1.2	3.1	1.1
By visiting different workplaces	3.5	1.2	4.1	1.1	4.0	.9
By visiting workplaces that I find particularly interesting.	3.9	1.2	4.4	0.9	4.3	.9
By doing TET-practices* in workplaces	3.6	1.3	4.1	1.1	4.0	1.1
By listening to a job representative's career story.	2.9	1.3	3.2	1.2	3.4	1.1
By looking introductory videos about different professions.	3.0	1.3	3.4	1.2	3.6	1.1
By doing tests on the Internet about which professions would suit me.	3.0	1.3	3.6	1.2	3.5	1.1
By participating in career counselling done outside the school.	2.4	1.3	2.8	1.2	3.0	1.1
By doing collaboration between schools and companies.	2.6	1.3	3.1	1.1	3.3	1.0

5.3 Which characteristics are perceived as important in the future professions among the secondary school students with STEM career aspirations?

Table 4 indicates that "good salary," "interesting work duties," and "good working atmosphere" were important when choosing a career in STEM, with means ranging from 4.34 to 4.79 for medical STEM students and 4.38 to 4.79 for general STEM interested students. The result further indicated that medical STEM students had a significantly higher mean preference for jobs that require working with people compared to the general STEM students with mean score of 4.3 (SD= 0.9) for medical STEM students compared to general STEM students, who had a mean score of 3.6 (SD = 1.1) and also for jobs that require helping other people with mean score of 4.4 (SD = 0.8) and 3.6 (SD = 1.1) for medical STEM and general STEM respectively. The result also showed significant difference in mean score for preference to jobs in technology development as the general STEM had an average mean score of 3.5 compared to a very low mean score of 1.9 for the medical STEM. The result of a Kruskal-Wallis test (see Appendix C) showed that there was significant difference among the three groups ($\chi2(2) = 123.3$, $p = < 0.001$) in "Working with people", ($\chi2(2) = 261.8$, $p = < 0.001$) "A job where I can help other people", and ($\chi2(2) = 373.4$, $p = < 0.001$) "A job in technology development". Post hoc test showing pairwise comparisons using Dunns' method (see Appendix D) further revealed that medical STEM was significantly different to general STEM in the three perceived job professions.

Finally, the study observed that there was little difference in the interest of students in jobs that allow them to develop society for the better, jobs with international duties, and jobs that require language skills. The mean values for both general STEM interested students and medical field interested students ranged from 3.2 to 3.6 and 3.4 to 3.5, respectively.

Table 3: Students STEM career aspirations and perceived profession characteristics

	No STEM		Medical STEM		General STEM	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Good salary.	4.2	.9	4.3	0.7	4.4	0.7
Interesting work duties.	4.5	.9	4.8	0.5	4.6	0.6
Interesting and varying working environments.	3.8	1.1	4.0	.9	4.1	0.9
Freedom to decide things for myself.	3.8	1.1	3.8	0.9	4.0	0.9
Good working atmosphere.	4.4	.9	4.8	0.5	4.6	0.7
Possibilities to affect the content of the work.	3.9	1.1	4.1	0.9	4.0	0.8
Working with people.	3.5	1.2	4.3	0.9	3.6	1.1
International duties.	3.1	1.3	3.2	1.2	3.4	1.1
A job that allows me to develop the society for the better.	3.0	1.3	3.4	1.1	3.6	1.2
A job where I can learn new things.	3.8	1.1	4.3	.8	4.2	.8
A job that is flexible for my needs, for example for my hobbies.	3.5	1.1	3.6	1.1	3.9	.9
A job where I can help other people.	3.2	1.2	4.4	0.8	3.6	1.1
A job in technology development.	2.3	1.3	1.9	1.0	3.5	1.1
A job where I can take advantage of language skills.	3.1	1.4	3.2	1.3	3.6	1.1

6 Discussions

The findings of this study investigated the factors contributing to compulsory basic school students' career aspirations in STEM fields, with particular emphasis on understanding different groups of students based on their career aspirations, preferred information sources, and perceived characteristics of future professions.

In this study, the first research question aimed to identify the different groups of students based on their career aspirations in STEM. Specifically, the question "What are the different groups of students when considering their STEM career aspirations?" revealed three STEM-groups: the No STEM field, the medical STEM field, who were specifically interested in medical-related STEM careers, and the general STEM group, whose interest cut across all STEM related fields in the selection. These findings are consistent with the Eccles' expectancy-value theory framework, which was used to guide this study, suggesting that students' interest in particular fields is influenced by their beliefs about their ability to succeed in a field of interest, as well as the value they place on that field (Eccles & Wigfield, 2002). Thus, these different groups of students may have chosen their STEM interests based on their expectancy of success in STEM and their perception of the benefits associated with pursuing a career in the STEM field. This finding also aligns with the finding by Kaleva et al., (2019) that students ranked ability and perceived necessity in future career aspirations. For example, the medical STEM group may have perceived a higher value in pursuing a career in medical-related STEM fields due to the potential for high salaries and need to help and care for people, while the general STEM group may have been motivated by a passion for science and technology related job fields, as well as the potential for contributing to innovation and improving society.

Prior research by Leaper, 2011; Van den Broeck et al., 2014, and more recent research by Wiebe et al. (2018) also agree with this, highlighting the significance of students' expectations of success in a particular domain in their school studies and the value placed on the domain for future career aspirations. The findings of this research indicated that the first group of students who show no interest in STEM fields may have a low perceived expectancy or beliefs in the ability to succeed in STEM subject fields and thereafter place no value and interests on taking up a career in STEM fields. This, in turn, may be associated to the students' profound choice of future career interests in STEM fields. This choice may be the result of students not being prepared for the burdensome college mathematics and science coursework that is needed for people majoring in STEM, as shown by reports by (Blotnicky et al., 2018; Nariman & Davis, 2021).

On the other hand, findings also showed that students in the general STEM had the highest number of students compared to the no STEM and medical STEM. These results highlight the importance of considering the perceived value of different career fields in understanding students' career aspirations in STEM, therefore suggesting that students' career choices are not solely influenced by their ability to succeed in a particular field, but also by the perceived value of that field in terms of potential earnings, societal impact, and personal fulfilment in future.

Regarding the second research question, this study aimed to investigate the preferred source of information for students with STEM career aspirations. The study findings revealed that students belonging to both medical and general STEM fields reported high interest in workplace visits and internship experiences acquired during TET practices. This suggests that the students perceived the information gained from such visits and internships as highly

beneficial for pursuing a career in STEM fields. This finding could be attributed to the Finnish government's continuous efforts to improve work-life collaborations with students and include them as part of the curriculum in schools, which has significantly increased students' interest in work life (OECD, 2020). This result is consistent with Anjum's (2020) study, which found that likelihood of students' engagement increases in a particular field when they have had positive experiences through internships and job shadowing, perhaps because of their visits to workplaces that they find particularly interesting. The results also revealed that the students in both medical STEM and general STEM highly regarded this information source as important in being updated on demands of professions in STEM and often these internships and workplace visits most likely expose them to social aspect of work-life (Bennett, 2007). Dabney et al. (2012) research also supports this idea, finding out that students' interest was piqued by the structured experiences they were exposed to during extracurricular activities like museum visits and programmes which van be inform of science groups, clubs, or camps, and science activities and mathematics competitions).

In the same vein**,** the high preference of information through workplace visits and TET practices among all groups in this study aligns with Capobianco et al. (2015) report that students highly estimate the role activities plays in providing them with valuable problem-solving skills and exposure in understanding of the profession as well as their own abilities to engage in the profession that could enhance their stronger career prospects in the field. Students in this study understands that visiting interesting workplaces and engaging in internship practises will provide them with enjoyable and fulfilling experiences (Masson et al., 2016), making the activity more personally meaningful to them and, increasing their self-concept and value of their abilities to perform in future classes (Simpkins et al., 2006) from compulsory basic education to tertiary

education, leading to achieving their STEM aspirations. The engaging and activities involved while visiting workplaces and engaging in TET practices is obviously one important reason most students opted for this as the most preferred information source shape their future career aspirations in STEM fields and therefore aligns with the view of Bennett (2007) that reported on the value of internships and educational visits to the workplace: students can learn a great deal from these resources and benefit from the mentorship programme that often goes hand in hand with them.

The results of this study also indicated low interest among students in participating in discussions with counselors. Both the medical and general STEM groups displayed disregard in external counseling and having conversations with guidance counselors, despite the potential benefits of engaging in such activities for their career development. This can be as a result that counsellors having limited time to talk about students' career alternatives, helping them to understand how to make informed decisions relating to their long-term career goals and focusing less on informing them on STEM career options that are related to different study fields of interest (Nikischer et al., 2016), contradicting the findings of (Murcia et al., 2020; Schmidt et al., 2012), who found that school counsellors are important in helping students understand the relationship between making academic choices and future STEM career goals and also that of Borghans et al. (2015), who reported the relevance of counsellors in reducing uncertainty regarding students view on their expectation of labour market, their job-specific needs and most importantly on how to understand oneself in relation to job preferences in future.

The low interest in counselling done outside of school among the two STEM groups could be explained by not having the ability to understand the information being conveyed to them during counselling sessions from outsiders and would rather prefer receiving counselling

support from informal educators such as parents (DeWitt & Archer, 2015), who they can understand easily and are free to engage in life shaping discussions with casually**.** Particularly in the case of medical STEM, their low interest could be explained by not valuing information gotten from counselling activities and would prefer to get the information from activities. For instance, they may believe that they can acquire more valuable information from participating in medicine profession design-based science learning activities to shape their medical career aspiration and exposing them to what is needed to succeed in the medical field. This correlates with the results of prior research of Capobianco et al. (2015) explaining the role of students engineering learning activities and how it shaped their engineering identity development.

The third research question in this study focused on the most important characteristics that students interested in STEM careers consider when deciding on their future career aspirations. Notably, students interested in the medical field place a perceived high value on caring for and providing help for people. These job characteristics in this study aligned with their interest in pursuing medical-related professions and is supported with prior studies that have noted the importance of caring and helping people as an important characteristic of the medical field (Adamson et al., 2003; Newton et al., 2009; Patterson et al., 2005; Ross et al., 2016). This informed decision and interests show that students in this group are well informed about the duties and demands of the medical profession. As discussed in the information preference for profession in STEM, this preference may have been influenced by their experiences during workplace visits and TET practices, where the students may have been steered up by what they have experienced over the visits to medical facilities and thereby now deem it as an important characteristic when choosing future career in STEM. These findings contradict previous research, including that of Blotnicky et al. (2018), who study underestimated the level of interest

in STEM careers that involve helping people, aligning with the principles of Eccles' expectancy-value theory J. Eccles (2011), J. S. Eccles & Wigfield (2002), Eccles (Parsons) et al. (1983), Wigfield & Eccles (2000), which emphasizes the significance of individual values for social contexts. For instance, students interested in the medical field may perceive careers in healthcare as more socially valuable and, therefore, place a higher value on them than other STEM fields.

Similarly, this study discovered that students interested in general STEM fields were drawn to jobs in technology and fields that allowed them to contribute to the development of society. This could be due to their early exposure to technological tools or the influence of their fathers, as suggested by Abe and Chikoko (2020). These results also align with those of Roberts et al. (2018), who reported that interest in STEM careers by students can be as result of exposure to hands-on activities and real-work life, which are important characteristics of technical jobs and information, communications, and technology (ICT) professions. For example, the general STEM student could be interested in developing software as a career in information technology which requires interests in problem solving and innovation through computer programming and engineering professions that demands working with different equipment.

Another finding from this study is the importance of students' preferences for job characteristics and professions that provide of employment security, key responsibility, meaningful work, and competitive pay and benefits in motivating people to pursue a specific career path (Gabris & Simo, 1995). According to Eccles' expectancy theory model, people's career aspirations are influenced by their perceptions of the physical outcomes associated with various career paths, such as job satisfaction, job security, and income. Previous research, including those by Lent et al. (1994) and Li et al. (2021), also further iterate that STEM career outcome expectations frequently include assumptions of high income in future, which is

consistent with the current study on the importance students place on choosing a future career based on perceived high income and adequate work-life balance from the career (Celenza et al., 2012).

6.1 Limitations of the study

The study's main limitation is the reliance on self-reported data, which could lead to response bias due to participants' subjectivity or their bias with socially acceptable jobs. This could limit the validity and reliability of the findings, potentially leading to a lack of generalizability in the wider student population.

Another limitation is the use of basic descriptive analysis techniques to examine the relationships in research questions 2 and 3. Using more advanced quantitative analysis methods could reveal underlying relationships and provide a more detailed understanding of the data.

Thirdly, this study did not include an analysis of students who have no interest in pursuing a STEM career. This group may have distinct differences in their career aspirations compared to those who are interested in STEM, which could provide additional insights into the factors that are associated with future career choices among students.

Future research can utilize a mixed-methods approach that incorporates open-ended questions, such as interviews, to gain a more comprehensive understanding of students' perceived job characteristics and preferred information sources. This approach allows students to express their career interests and motivations in their own words, providing deeper insights into their decision-making processes and the factors that influence their STEM career aspirations. By giving students the freedom to share their thoughts and experiences, researchers can obtain a more complex understanding of STEM career choice and improve career counseling and education for students.

6.2 Ethical Issues

The ethical issues involved in this study were given careful consideration because they were of utmost importance. The data used in this study was provided by a research team at the University of Oulu, and use of the data was properly authorized. Strict data management protocols were implemented to ensure the confidentiality and integrity of the data during both storage and analysis phases. Additionally, to uphold privacy standards, the data used for this study will be securely deleted upon the completion of the research as required by the data provided.

The study's findings were reported with accuracy, and the interpretation and conclusions of the study appropriately reflected the data (BHBIA, n.d.), without any fabrication or manipulation during the analysis stage. Bias and conflicts of interest were avoided throughout the entire research process. When presenting the study's findings, transparency and accuracy were given top priority to ensure an accurate representation of the findings.

6.3 Reliability and Validity

In this study, special attention was given to ensuring the reliability and validity of the data used. The questionnaire utilized in the study was developed and administered by the primary users of the data, a research unit within the Faculty of Education at the University of Oulu (Kaleva et al., 2019, 2023). This aspect enhances the reliability of the data as it was designed and implemented by educational researchers who have wide knowledge and experience in the field of education.

Furthermore, the use of an established online tool, such as Webropol, in data collection increases the reliability of the process by providing standardized procedures and safeguards against potential errors or biases. Moreover, to ensure a representative sample, the researcher distributed the survey to schools in Oulu via principals, student counsellors, and subject teachers. Also, conducting the data collection during school class hours adds to the sample's

representativeness by ensuring that a diverse range of students had the opportunity to participate. This approach enhances the overall validity of the study and strengthens confidence in the findings and conclusions drawn from the collected data.

Prior to participating in the study, each respondent provided their consent for their responses to be used, ensuring ethical data usage. This commitment to respecting the participants' rights strengthens the reliability and validity of the data by ensuring that the data collected is voluntary and based on informed consent.

The study also received permission from the City of Oulu and the Department of Education and Culture, further validating the research process and ensuring that the study was conducted in compliance with relevant regulations and guidelines. This authorization adds credibility and reliability to the study's findings, as it signifies that the research was conducted with proper approval and oversight.

Overall, this study carefully assessed the reliability and validity of the data before using it. This rigorous process increased the trustworthiness of the research findings and provided assurance in the conclusions drawn from the collected data.

7 Conclusion

This study investigated the factors that contribute to secondary school students' career aspirations in STEM fields, with emphasis on understanding different groups of students based on their career aspirations, preferred information sources, and perceived characteristics of future professions.

The results indicate that students' STEM career aspirations are divided into three groups: no STEM, medical STEM, and general STEM. Although the groups were almost evenly distributed, the general STEM group had a higher number of students than the no STEM and medical STEM groups.

The study shows in the result of RQ2 that workplace visits and TET practices are highly preferred sources of information for both medical and general STEM students, while counseling done outside school is the least preferred. The findings further show that medical STEM and general STEM students also exhibit similar moderate preferences for accessing information on future STEM professions through online tests. However, general STEM students further show a moderate preference for acquiring information through introductory videos. Therefore, as a result, more workplace visits and TET practices are required to increase STEM interest among students. Furthermore, encouraging more students to pursue STEM careers, closing the industry's skill gap. Educators and policymakers can also therefore assist students in pursuing STEM careers that align with their interests and aspirations, while emphasizing the importance of a variety of information sources. To engage students more effectively, educational stakeholders in Finland can improve counsellor training on STEM fields and career. This can help raise awareness among teachers and counsellors about the demands and importance of STEM careers, as students interested in both medical and general STEM fields do not enjoy discussions with

counsellors, most especially outside the schools, this could possibly be due to uninspiring career talks.

The findings of RQ3 show that when choosing a STEM career path, students prioritize job characteristics such as a good salary, interesting work duties, and a good working environment. Furthermore, medical STEM students are drawn to roles that require them to help others and work with people, whereas general STEM students are drawn to careers that emphasize technological advancements. These findings show that students have a clear understanding of their future career goals and can use this knowledge to motivate them to pursue STEM careers in future.

Using Eccles' expectancy-value theory, students can pursue fulfilling careers in STEM by identifying their strengths and interests and developing expectancy beliefs. Teachers and counselors should raise awareness about STEM careers through training and retraining and incorporate students' interests into STEM curricula. Policymakers can use these findings to promote STEM education, provide resources for STEM programs and activities, and develop effective interventions. Career counselors and teachers can provide tailored advice and support for students interested in STEM fields, while using activity-based counseling to make sessions more engaging and steer students towards STEM-related careers.

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Appendices

Appendix A: Questions derived from My Future Questionnaire

Are you interested in the fields of study below?

- Cultivation areas
- Arts and cultural fields
- Humanities
- Social sectors
- Business, Administration and Law
- Science
- Information processing industries
- Fields of technology
- Agriculture and forestry sectors
- Medical sciences
- Health and wellness sectors
- Services

How would you like to get to know different professions?

- By having discussions with the guidance counsellors.
- By visiting different workplaces
- By visiting workplaces that I find particularly interesting.
- By doing TET-practices* in workplaces
- By listening to a job representative's career story.
- By looking introductory videos about different professions.

- By doing tests on the Internet about which professions would suit me.
- By participating in career counselling done outside the school.
- By doing collaboration between schools and companies.

What are the important things for you when choosing a future job?

- Good salary
- Interesting work duties
- Interesting and varying working environments
- Freedom to decide things for myself.
- Good working atmosphere
- Possibilities to affect the content of the work.
- Working with people
- International duties
- A job that allows me to develop the society for the better
- A job where I can learn new things.
- A job that is flexible for my needs, for example for my hobbies
- A job where I can help other people.
- A job in technology development
- A job where I can take advantage of language skills.

The scale is from 1 strongly disagree to 5 strongly agree.

Appendix B: Tests of Normality for perceived future profession characteristics

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Good salary.	,268	1454	<,001	,745	1454	<,001
Interesting work duties.	,410	1454	,000	,564	1454	<,001
Interesting and varying working environments.	,224	1454	<,001	,842	1454	<,001
Freedom to decide things for myself.	,232	1454	<,001	,862	1454	<,001
Good working atmosphere.	,399	1454	,000	,610	1454	<,001
Possibilities to affect the content of the work.	,233	1454	<,001	,843	1454	<,001
Working with people.	,205	1454	<,001	,865	1454	<,001
International duties.	,178	1454	<,001	,908	1454	<,001
A job that allows me to develop the society for the better.	,176	1454	<,001	,904	1454	<,001
A job where I can learn new things.	,238	1454	<,001	,814	1454	<,001
A job that is flexible for my needs, for example for my hobbies.	,193	1454	<,001	,880	1454	<,001
A job where I can help	,198	1454	<,001	,863	1454	<,001

other people.						
A job in technology development.	,181	1454	<,001	,879	1454	<,001
A job where I can take advantage of language skills.	,189	1454	<,001	,897	1454	<,001

a. Lilliefors Significance Correction

Appendix C: Kruskal Wallis Test Statistics for perceived future profession characteristics

	Kruskal-Wallis H	df	Asymp. Sig.
Good salary.	9,399	2	,009
Interesting work duties.	38,162	2	<,001
Interesting and varying working environments.	12,812	2	,002
Freedom to decide things for myself.	8,096	2	,017
Good working atmosphere.	51,170	2	<,001
Possibilities to affect the content of the work.	4,985	2	,083
Working with people.	123,291	2	<,001
International duties.	25,012	2	<,001
A job that allows me to develop the society for the better.	65,502	2	<,001
A job where I can learn new things.	42,897	2	<,001
A job that is flexible for my needs, for example for my hobbies.	31,418	2	<,001

A job where I can help other people.	261,767	2	<,001
A job in technology development.	373,378	2	<,001
A job where I can take advantage of language skills.	28,287	2	<,001

a. Kruskal Wallis Test
b. Grouping Variable: STEM Career Aspirations

Appendix D: Pairwise comparisons using Dunns' method.

Pairwise Comparisons on working with people

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
No STEM -General STEM	-33,957	25,845	-1,314	,189	,567
No STEM -Medical STEM	-266,811	26,511	-10,064	,000	,000
General STEM -Medical STEM	232,854	25,474	9,141	,000	,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons on job where I can help other people.

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
No STEM -General STEM	-132,395	25,880	-5,116	<,001	,000
No STEM -Medical STEM	-417,899	26,547	-15,742	,000	,000
General STEM -Medical STEM	285,504	25,509	11,192	,000	,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons on job in technology development

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Medical STEM-No STEM	127,831	26,873	4,757	<,001	,000
Medical STEM-General STEM	-479,224	25,822	-18,559	,000	,000
No STEM -General STEM	-351,393	26,197	-13,414	,000	,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.