Doctoral Dissertation

Factor affecting Cambodian Upper Secondary School Female Students' Science, Technology, Engineering and Mathematics (STEM) Careers Choice

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SAR MONYRATH

DEDICATION

Upon the successful completion of this dissertation, I dedicate this work to my beloved father, **SAR Tharch**, to whom I owe deep gratitude.

I appreciate him telling me that he wants me to study hard because the only thing he could give me is financial support for my education. He said that the only thing he wanted from me as his daughter was to see me complete higher education. With such profound words and his hope placed in me, I owe him a lot. My biggest regret is that I did not have enough time to repay him with my gratitude, as I should have done. He was just a farmer, but he was willing to do everything to support my education. He loved and valued education the most. He had big hopes for his only daughter, and he will be remembered. My hope is that he is in heaven and would be very happy and proud to see his only daughter's achievement.

SUMMARY

Science, technology, engineering, and mathematics (STEM) have been highlighted as growth programs to boost national economic and societal advancement, as specified in the Industrial Development Policy of Cambodia 2015–2025 (Ministry of Education, Youth and Sport [MoEYS], 2016). Promoting gender equality in STEM education is one of the STEM policy strategies, which entails encouraging female students to pursue an education involving and conduct research on STEM subjects and providing opportunities for both women and men at education-related institutions including those that conduct research on STEM education.

More female adolescents are attending higher education institutions nowadays compared to their rate of participation in the past, but they do not continually get equal opportunities compared to their male counterparts to finish and take advantage of training programs that suit their preference. Gender inequality is frightening, particularly as STEM professions are frequently suggested as the professions of the upcoming day, pushing improvement, public wellbeing, comprehensive development, and sustainable growth. Many schools and higher education curricula have been created with the specific purpose of encouraging females to choose science majors. Regardless of these efforts, career choice is still firmly based on gender stereotypes. It has been revealed that females are downplayed in STEM research (Nagy et al., 2008). For instance, engineering is still a male-dominated area. In this study, the researcher focused on factors influencing the career choices of upper secondary school female students, specifically twelfth graders in their last year of upper secondary education.

International research has provided a deep understanding of career development and career choice. The factors influencing career development have been comprehensively identified and recognized as intrapersonal or contextual. These include outcomes related to the significance of factors that influence students' career choices in the context of developing

countries with a strong cultural influence and a big gender equality gap, such as Cambodia. Those factors involve the family, the individual, and the psychological, schools, and society. Many studies on the factors influencing students' career choices have been conducted in developed countries; however, there is no existing study focusing on the factors influencing students', especially female students', career choices in Cambodia. Kao and Shimizu (2019, 2020) studied the factors affecting students' choice of science and engineering majors in higher education and the factors affecting Cambodian upper secondary school students' choice of the science track. However, these two studies mainly focused on students' major and subject choice, not their career choices.

This study aimed to examine the factors influencing Cambodian upper secondary school students' STEM career choices by holistically conceptualizing the different dimensions of family, personal, school, environment, and social. The second purpose was to examine the most predictive factors influencing Cambodian female upper secondary school students' STEM career choices, in particular.

In the current study, a survey was created based on former instruments (Besigomwe, 2019; Halim et al., 2018; Mtemeri, 2017; Kier et al., 2013), together with a modified social cognitive career theory (SCCT) model that was used to test a portion of SCCT (Lent et al., 1994, 2000). The theoretical framework was adopted from a theory on career choice and development among female construction professionals (Moore, 2006), and the researcher developed the variables based on the Cambodian context as well as those of other developing countries in conjunction with the current status of STEM education. A sample of high school students in Grade 12 was used. SCCT was psychometrically assessed with respect to factors expected to affect career choice and applied to the STEM career choice survey questionnaire designed in this study. The researcher created a 110-item instrument, with five statements per SCCT characteristic. Based on advice from science educators, the researcher decided to use a 5-point Likert-type scale (where 1= *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*). The items were properly linked to all the characteristics of SCCT, and the survey questionnaire was understandable to upper secondary students.

To tackle the problems represented in the two research objectives, binary logistic regression, which makes use of one or more predictor variable(s) that may be either continuous or categorical to predict the target variable classes, was employed. To solve the problems, a block recursive model that makes specific assumptions about the causal order of individual, family, school, and environmental and sociological variables was used. Particularly, the independent variables were entered into four 'blocks'. Other statistical analyses such as descriptive statistics, factor analysis, Cronbach's alpha, and correlation were also employed.

To elucidate the issues surrounding the main research purpose, the current study attempted to answer two research questions. The results are as follows.

- Regarding *Research Question 1* on Cambodian upper secondary school students' STEM career choices, the study found that the individual factors 'gender' and 'upper secondary school stream' affected STEM career choice.
- Regarding *Research Question 2* on Cambodian female upper secondary school students' STEM career choices, the study found that the individual factors 'upper secondary school stream' and 'interest in a STEM career' affected female students' STEM career choice.

According to the findings of the current study, individual factors are the most influential in terms of predicting STEM career choice among both male and female students at the Cambodian upper secondary school level. We should pay more attention to the other indirect influencing factors in order to help students be aware of their decision making regarding selecting a major for their higher education and a career in the future by giving them proper guidelines and a beneficial orientation. This is important because making the wrong decision could ruin their future professional life.

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LIST OF ABBREVIATIONS

ACC	Accreditation Committee of Cambodia
ASEAN	Association of Southeast Asian Nations
CLCs	Community Learning Centers
CDRI	Cambodian Development Research Institute
CPRK	Cambodia People’s Republic of Kampuchea
GDP	Gross Domestic Product
MoEYS	Ministry of Education, Youth, and Sport
MoLVT	Ministry of Labour and Vocational Training
PTCs	Provincial Training Centers
SLT	Social Learning Theory
SCT	Social Career Theory
SCCT	Social Cognitive Career Theory
STEM	Science, Technology, Engineering, and Mathematics
TVE	Technical and vocational education
TVET	Technical and vocational education and training
UNICEF	United Nations International Children's Emergency Fund
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNTAC	United Nations Transitional Authority in Cambodia
VTCs	Vocational Training Centers
VSTP	Voucher Skills Training Program

CHAPTER 1: INTRODUCTION

1.1 Research background

1.1.1 Science, Technology, Engineering, and Mathematics (STEM)'s contributions to economic development

STEM is an acronym normally used to describe education or professional practice in the areas of science, technology, engineering, and mathematics. STEM content is expected to build students' 'conceptual knowledge of the interrelated nature of science and mathematics, in order to allow students to develop their understanding of engineering and technology' (Hernandez et al., 2014). STEM majors include not only the common categories of mathematics, the natural sciences, engineering, and computer/information science but also social/behavioural sciences such as psychology, economics, sociology, and political science (Kao, 2021).

As cited in Sari et al. (2017): 'The 21st century is a technology age and STEM education plays an important role in influencing the culture and economic development with a viewpoint of innovativeness, creativity and problem-solving (Cooper & Heaverlo, 2013)'. Numerous countries in the world have created important assets in STEM learning resourcefulness motivated by interests about possible shortages of STEM-certified specialists in the future (Langen & Dekkers, 2005; McDonald, 2016). The upcoming success of various countries' is based on long-term involvement with STEM learning. In the next 5–10 years, 75% of the quickest developing professions will require STEM-related competences and experiences (Chubb, 2013). Universal concern with STEM has seen a considerable boost recently as an immediate outcome of the decreasing interest in STEM-related professions and the estimated consequences of this trend both today and in the future (McDonald, 2016). Current international learning programs and education reforms have concentrated on expanding the number of learners engaged in STEM disciplines in order to guarantee that learners are being readied and properly trained to participate in STEM professions (McDonald, 2016). According to the Office of the Chief Scientist (2014), focusing on STEM fields has risen in popularity not only out of a perceived deficiency of trained labour in new extremely high-tech subjects of professional, nevertheless also in relative to concern about STEM components being taught as separate topics in educational institutions rather than all together within an integrated syllabus. Holmes et al. (2018) suggested that as the gaps in STEM involvement are becoming severe, it is important to consider who wants and does not want to be involved in STEM because this will give sensible images to educators, institute career advice-givers and educationalists, concerning productive paths to restore the apparent failure of students' attention to STEM.

1.1.2 STEM careers and the importance of STEM career choices

There is no standard definition of a STEM occupation. For the purposes of this quick probe, STEM incorporates professional and technical support occupations in the areas of life and physical sciences, computer science and mathematics, and engineering (Noonan, 2017). A simple definition is that a STEM career is any position in science, technology, engineering, and mathematics. Such positions can be found across an array of sectors, including private businesses and big corporations and non-profit organizations and the civil service. A STEM career also requires knowledge of the practices and processes that overlap and intersect across the four disciplines. A person who has a career may be able to live a good and fulfilling life. Such a person will likely be able to support a family because they have made a good career choice. This and many things show how relevant a career is in the lives of all humans (Bossman, 2014). Indeed, career choice is as important as choosing a life partner since it is also a lifetime process. Just as one becomes miserable when one chooses the wrong spouse, one can also become very unhappy if one's career was not well planned (Bedu–Addo, 2000).

1.2 Research problems

According to the Cambodia Development Research Institute (CDRI, 2015), Cambodia needs 35,000 engineers and 4,600 technicians to maintain the nation's 6%–8% achievement regarding the gross domestic product (GDP) over the next 5 years. The Royal Government of Cambodia has been paying close attention to these skills by strengthening and expanding STEM education to serve national economic development and respond to career market demands as well as the Association of Southeast Asian Nations (ASEAN) integration. To help realize the Cambodia Industrial Development Policy 2015–2020, as indicated in the STEM education policy (2016), MoEYS has also highlighted that being a developing country and a growing economy, the Cambodian nation is in need of graduates in STEM fields. Therefore, to promote STEM education, MoEYS has published a policy on STEM education because STEM subjects and skills are at the forefront in terms of realizing Cambodia's long-term visions for 2030 and 2050, as specified in the Industrial Development Policy of Cambodia.

As cited in Holmes et al. (2018): 'Decreasing registrations and involvement in STEM fields is an important matter for the reason that building capacity in the STEM fields is an essential factor to preserving/growing output and universal competitiveness (Marginson, Tytler, Freeman & Robert, 2013; Office of the Chief Scientist, 2013)'. This issue has become increasingly concerning in a period when society is becoming more dependent on compound technologies. According to the Office of the Chief Scientist (2014), focusing on STEM fields has risen in popularity not only out of a perceived deficiency of trained labour in new and extremely high-tech professions but also due to concern about STEM subjects being taught as separate topics in schools rather than as part of an integrated syllabus. Holmes et al. (2018) suggested that as the gaps in STEM involvement are becoming serious, a thorough understanding of who is and is not interested in STEM will give educators and career counsellors valuable clues to devise productive paths to restore the apparent lapse in students' attention to STEM.

1.3 Research purpose

This study aimed to examine the factors influencing Cambodian upper secondary school students' STEM career choices by holistically conceptualizing the different dimensions of family, personal, school, the environment, and sociological aspects. The study also sought to examine the most strongly predictive factors influencing Cambodian female upper secondary school students' STEM career choices.

1.4 Research questions

To achieve the aforementioned objectives, the current study can be understood as a combination of two related minor studies, the specific purposes of which were to answer the following two related research questions.

1. What are the factors influencing Cambodian upper secondary school students' STEM career choices?
2. What are the most strongly predictive factors influencing Cambodian female upper secondary school students' STEM career choices?

1.5 Significance of the research

The study was designed to fill the gaps in the literature not only with regard to the Cambodian context but also with respect to the Southeast Asian context in terms of promoting students' interest in STEM at the upper secondary school level in order to meet the need for human resources to support the nation's new trend of economic development. The current study was the first of its kind to identify the factors that explain Cambodian upper secondary school students' STEM career choices. This study aimed at introducing a new perspective to rethink the importance of multi-dimensional factors that can be manipulated to stimulate higher enrolment in STEM in tertiary education starting with adequate preparation at the upper secondary school level, with the goal of producing STEM professionals.

1.6 Limitations of the study

The results of this study should be interpreted in light of the following methodological limitations. Firstly, 'career choice' in this study referred to upper secondary school students' intended, not actual, career. Secondly, due to time constraints and the Covid-19 pandemic, data collection was conducted online using Google forms because the researcher could not travel to their home country, Cambodia. For the same reasons, the samples for this study were not very large compared to some other studies conducted elsewhere. Thirdly, given the lack of proper career guidance, students might change their career choice after they finish their high school or higher education. Future research should use a large sample size and track student career choice after graduation from high school or a higher education institution in order to compare the actual choice to the intended choice and further investigate the factors influencing career choice.

1.7 Structure of the dissertation

This dissertation is segmented into eight chapters. Chapter 1 highlights the research background, problems, research objectives, the significance of the study, and its limitations. Chapter 2 discusses and synthesizes extant career development theories and conceptual models on career choice. Chapter 2 aims at elucidating the conceptual constructs and dimensions employed in the current study. Chapter 3 is a literature review of factors influencing students' STEM career choices. Chapter 4 explains the research methodology, including the sampling process, development of the research instrument, data analysis, analytical tools, and so forth. Chapter 5 presents the results and discussion the findings of research question 1, and Chapter 6 presents the results and discussion the findings of research question 2. Chapter 7 explain and present the results and discussion of weighted sample case analysis . The last, chapter 8 concludes and offers implications regarding how to solve the problem of interest. The structure of this dissertation is presented graphically in Figure 1.1 below.

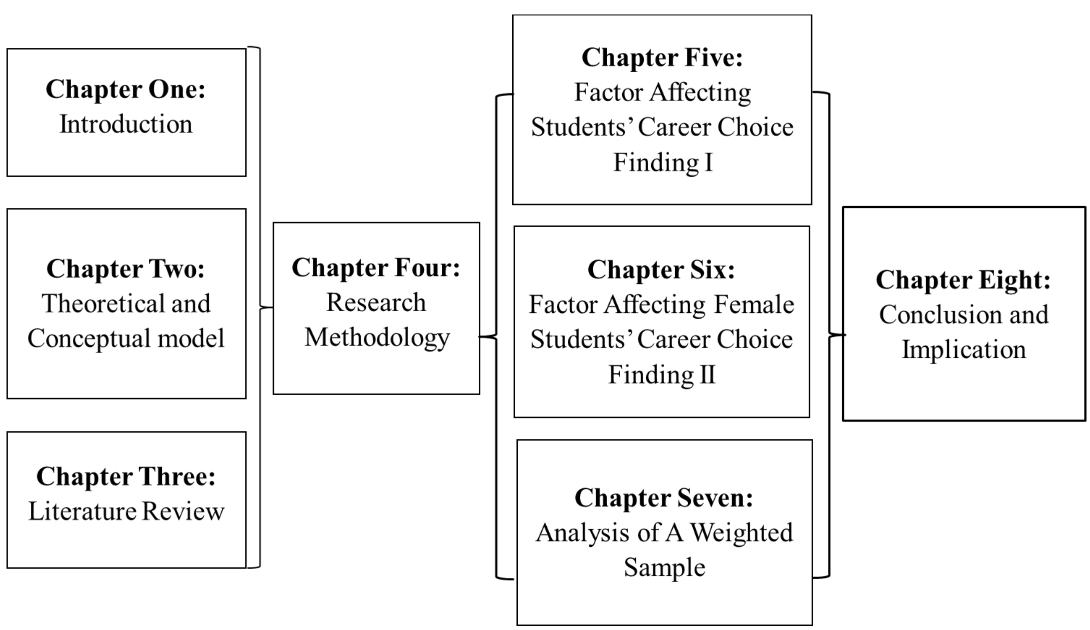


Figure 1.1 : Graphical structure of the dissertation

CHAPTER 2: THEORETICAL AND CONCEPTUAL CAREER CHOICE MODELS

Six theoretical pillars were used in this study to better explain students' career choices: Occupational Choice (Ginzberg et al., 1951), vocational choice theory (Super, 1954), Holland's (1959) career typology, social learning theory (SLT; Krumboltz, 1979), social cognitive theory (SCT; Bandura, 1986), and SCCT (Brown et al., 1987), alongside a female-oriented construction management model (Moore, 2006). The six theories reviewed in this study are the predominant career theories for research on career development and career choice.

2.1 Six theoretical foundations to understand students' career choice and a model of women construction management

2.1.1 Ginzberg's (1951) occupational choice thesis

According to Ginzberg's thesis, there are four elements that affect students' career decisions and three phases of professional growth. Education, vision, values, objectives, skill, and interest are the theory's main constituents. However, because factors such as gender, ethnicity, and socioeconomic status might open or close the door to career options, this idea does not apply to all adolescents.

2.1.2 Super's vocational choice theory (1954)

The six stages of Super's theory are centred on self-concept and experience. As a result of experience, people's self-concept evolves and changes during the course of their life. This theory neglects women, persons of colour, and the impoverished. .

2.1.3 Holland's career typology (1959)

According to Holland's thesis, correlations exist between the six personality types and the six work contexts, concentrating primarily on behaviour. People are drawn to a specific profession when it satisfies their requirements and makes them happy. Given that women tend to score higher on three of the personality types and given the cultural characteristics that direct women into female-dominated careers, there is gender bias in this hypothesis.

2.1.4 Krumboltz’s social learning theory-SLT (1979)

The four components of Krumzbolt's thesis are mostly centred on beliefs. Self-observation generalization, worldview generalization, task approach skills, and behaviour comprise people's beliefs. The two groups and individuals can both benefit from this notion.

2.1.5 Bandura’s social cognitive theory-SCT (1986)

The three basic components of Bandura's theory are motives, behaviours, and experience. A person's performance is influenced by a combination of their personal traits, other people's behaviours and actions, and external variables.

2.1.6 Brown et al.’s (1987) social cognitive career theory-SCCT

The Social Cognitive Career Theory (SCCT emphasizes four main factors: beliefs, self-efficacy, expected results, and personal goals. This theory, which developed based on SCT, attempts to consider the concerns associated with culture, gender, genetic endowment, social environment, and unforeseen life events that may interact with and exceed the impacts of career-related decisions. SCCT focuses on the influence of self-efficacy, expected results, and personal aspirations on an individual's career choice.

2.1.7 Model of women on construction management (Moore, 2006).

This career model refers to typically male-dominated academic and professional disciplines and focuses on the causes underlying non-traditional career choices. Most women do not aspire to work in male-dominated professions, which are described as specialties associated with the masculine gender role (Winkelman, 1999). This paradigm emphasizes factors related to the family (parental influence and gender roles in the home), the individual (ability, achievement, self-efficacy, and career aspirations), school (educational climate), and environmental and sociological factors (gender stereotypes, the presence of role models and mentors, and the availability of counselling and advice).

Table 2.1: Summary of the primary and most prevalent of six career development theories

Theory of Career Choice	**Stages & Factors**	**Focus on**	**Overview**
Ginzberg	3 stages /4 factors	Education, vision, skills values, goals, and interest	Due to the differences between males and girls, colour, and socioeconomic background, which might open or close the door to career choosing, this hypothesis does not apply to all adolescents.
Super	6 stages	Self-concept and experience	Self-concept evolves and advances throughout a person's life as a result of practice. This study has severe gender, racial, and poor.
Holland	Relationship of 6 personality & 6 Occupational Environments	Behaviour	People pay attention to occupations that fit their personal goals and aspirations. Females appear to be classed in three-character kinds and traits to our community that separate women into women because of the injustice between male and female. professionals who predominate.

Krumzbolt	4 factors	Belief	Beliefs of individuals: generalizations of self-observation, worldview, task approach, and behaviours. Groups and individuals can both benefit from the theory.
Bandura	3 mains factors	Motives, behaviours, and experience	A person's productivity is influenced by a variety of factors, including 1. Personal attractiveness. 2. In their view, both their conduct and other activities. 3. Outside sources.
Brown, Hackett	4 majors influence	Beliefs, self-efficacy, outcome expectation, and personal goal.	The evolution of Bandura's SCT seeks to address issues with society's ideals, gender roles, hereditary gifts, social context, and unforeseen life events that could complement or displace the effects of professional-related selection. The SCCT places emphasis on how a person's choice of work is influenced by their self-efficacy, result expectancies, and personal aspirations.

2.2 Synthesis of theoretical and conceptual models and empirical evidence

Career choice decision making is complicated by the variety of career options. The career choice model Gelatt developed in 1962 depicts the process of choosing a vocation as an ongoing activity that is influenced by external information sources. One of the most significant concepts that might influence career choice is outcome expectation. In light of individuals' socioeconomic condition and expected results in terms of self-satisfaction, the model evaluates teenagers' belief in the feasibility of a variety of occupations (Abe & Chikoko, 2020). Along with career desire and expected result, another construct called ‘career interest’ also serves as a prognosticator (Nuget et al., 2015). Self-efficacy as a personal component was investigated as a predictor of career interest, in addition to the prior construct.

Numerous career development theories are currently in existence, including occupational choice (Ginzberg et al., 1951), vocational choice theory (Super, 1954), Holland's (1959) career typology, SLT (Krumboltz, 1979), SCT (Bandura, 1986), and SCCT (Brown et al., 1987). Most career development theories, with the exception of SCCT, concentrate on personal cognitive factors and do not include other personal variables in their models.

SCCT (Lent et al., 1994) was developed based on SCT and attempts to stress extra-personal (e.g., contextual) variables combined with personal cognitive variables that allow people to influence their professional growth. Extra-personal variables such as issues related to culture, gender, genetic endowment, public situation, and unforeseen life events that may work with personal cognitive variables and outweigh the influences of vocation-related choices are intended to clarify the behaviours through which people formulate vocational preferences, set goals, and enter and operate in the workplace.

The results of Lent et al.’s (2018) meta-analysis of 143 studies from the period 1983 through 2013 largely support the use of the SCCT model in STEM disciplines, both in the wider sample of studies as well as in samples predominantly comprised of either females or males and/or members of racial/ethnic minorities or majorities. Consequently, the model seemed to be generalizable to the groups we tested and accounted for at least as much variation in the decision objectives of both women and men as well as in samples of people of colour and Caucasian samples. Self-efficacy and expected results generally worked as predicted in terms of moderating the linkages between contextual variables (particularly support) and STEM-related interest and career choice, despite gender and racial/ethnic variations regarding some of the routes in the choice model.

Similar to many career theories, the extant research has often focused on research subjects who are about to attend or already graduated from college. However, many professional development theories feature gender prejudice, gender discrimination, and the exclusion of persons from different racial and socioeconomic backgrounds. Despite the fact that community influence is not seen to be the most significant factor influencing self-efficacy, it is anticipated that these messages will impact young females' self-efficacy and capacity to succeed in a science major. Understanding the main factors that influence self-efficacy in males and females might encourage females to pursue less conventional degrees.

Additionally, examining the differences in other SCCT variables (primarily interest and expected results) between male and female science majors could enhance students' comprehension of their career choices (Lent et al., 2000). According to Kao and Shimizu (2019), factors such as students' success in math and science and their attitude toward science during upper secondary school, as well as their parents' occupations, their siblings' and relatives' majors, and the support of science and mathematics teachers at their school are the most significant influences on students' decision to major in science and engineering in advanced schooling in Cambodia. Hartman and Hartman (2008) discovered that men and women differ in that men encounter less obstacles (related to social support, value conflicts, assurance, etc.) regarding undertaking science and engineering courses than women. Kao (2013) also noted gender as an aspect influencing the selection of a major. In Cambodia, there are often fewer women than men studying engineering and pure science (Eam et al., 2019). There are several reasons for this, such as gender stereotypes, male-dominated societies, a lack of role female models, math anxiety, and others, that affect females' decision to pursue careers in STEM, as previously discussed. To narrow and eventually close the gender gap in STEM fields, it is necessary to understand the variables or impediments specific to the Cambodian environment. To identify the elements impacting Cambodian female secondary students' career choice, we must first understand the role of secondary education in giving students the opportunity to choose their higher education path (i.e., it is the education stage involving career preparation). Several studies have been conducted on factors influencing female students' career choices in industrialized nations, but no prior research has concentrated on those aspects in the context of Cambodia.

In Cambodia, there is still a significant gender equality gap and a considerable cultural effect. The SCCT model was used in this study, however, it was modified to suit the Cambodian setting. The participants were a sample of Cambodian twelfth graders. The study applied a modified SCCT model that was used to test a portion of the SCCT and adopted a theoretical framework based on Moore's (2006) career choice and development model for female construction professionals. The researcher developed the variables based on the Cambodian context and the current STEM education situation.

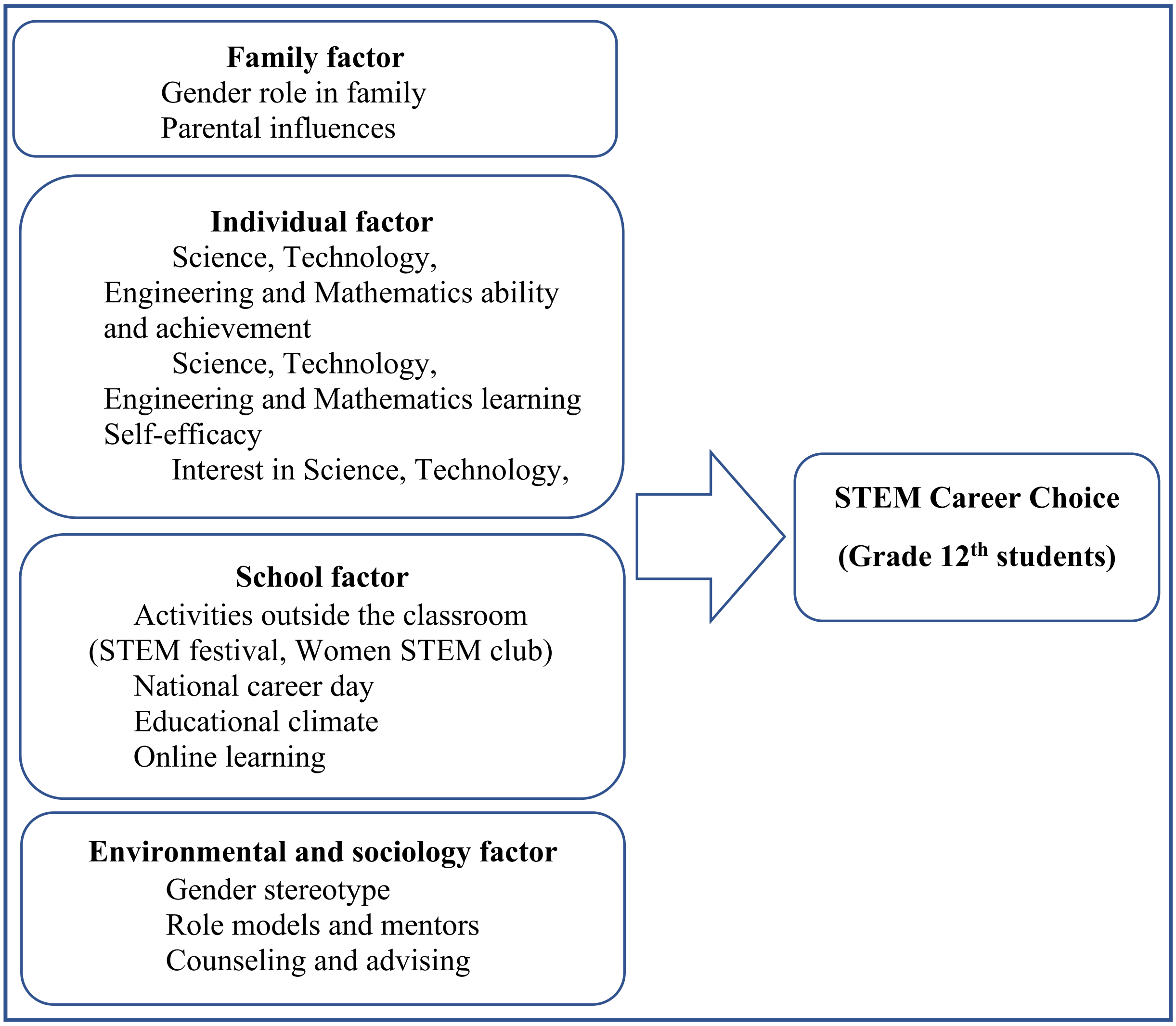


Figure 2.1: Synthesis of literature and SCCT

CHAPTER 3: LITERATURE REVIEW

3.1 General education system in Cambodia

In Cambodia, the first instruction was provided in a pagoda at a Buddhist shrine known in Khmer as ‘Wat’. There was no set curriculum or roster of subjects. Under French colonial rule, the previous educational system was replaced with a Westernized one beginning in 1864. Given that the majority of schools were located in the capital city, the French paid little attention to teaching the Khmer language. The first high school was established in the late 1930s. In the 1950s and 1960s, after Cambodia attained independence, Prince Norodom Shihanouk’s regime achieved notable strides in the realm of education. The country's elementary and secondary education systems were enlarged, and universities, teacher training programs, and vocational schools were established.

The Pol Pot administration, often known as the notorious Khmer Rouge, destroyed Cambodia in the period 1975 to 1979 and over 1.7 million people were killed in the civil war that ensued. Individuals with a higher education, including physicians, attorneys, teachers, civil servants, professors, and persons who were college students at the time of the outbreak of the war, were murdered or sent to labour in concentration camps. Additionally, Khmer Rouge physically destroyed libraries and other academic buildings, institutional infrastructure, and higher education facilities. Of the 20,000 pre-war instructors, 75%–80% of Cambodian educators were murdered, died from overwork, or fled the nation, and barely 7,000 teachers remained. The majority of those who perished during the conflict were well educated, including government officials, teachers, students, and some of the greatest vocalists. Additionally, the whole educational system was destroyed, along with the stock of books. Laboratory supplies and equipment were also left to decay or burned.

In January 1997, the People's Republic of Kampuchea, with Vietnamese assistance, fought to free Cambodia from Khmer Rouge (Ayres, 1999; UNTAC, 1992). Even after the Khmer Rouge army surrendered and joined the Royal Government of Cambodia, there were still some Khmer Rouge members in the northern region who continued fighting intermittently up to 1999.

Following the fall of Khmer Rouge, education in Cambodia began to improve and was given high priority, with aid from communist Vietnam and other countries in the socialist bloc. Despite tremendous advances, the ongoing civil war and resource shortage, including human and material capital, hindered the educational rebuilding process. At that time, Vietnam's educational system was imported into Cambodia. Approximately 6,000 educational institutions were restored thanks to the kind help of the International Red Cross, the United Nations International Children's Emergency Fund (UNICEF), and Cambodia's People's Republic of Kampuchea (CPRK). The catchphrase at the time was ‘Those who know more educate those who know less’. Any educated person was invited to work as a teacher, and attempts were made to locate retired educators, academics, and administrators and persuade them to participate in this challenging undertaking. Given the urgency of the situation, a duration of 1 month, 3 weeks, or even less was allotted for the training of prospective teachers, after which they were given teaching positions. Many instructors subsequently received additional training, and the standard of instruction progressively rose. In 1989, elementary and lower secondary school enrolment totalled 1.3 million and 0.24 million, up from just 0.9 million and 4,800, respectively, in 1980 (Ministry of Education, Youth and Sport, 1999).

Cambodia’s school system underwent the following four reforms.

- Before 1975, there was a 10-year education system (3+3+4, i.e., 3 years of primary school + 3 years of lower secondary school + 4 years of upper secondary school).
- From 1979 to 1986, there was a 4+3+3 education system (i.e., 4 years of primary school, 3 years of lower secondary school, and 3 years of upper secondary school).
- From 1986 to 1996, there was a 5+3+3 education system, with 11 years of basic education (i.e., 5 years of primary school, 3 years of lower secondary school, and 3 years of upper secondary school).
- In 1996, a 12-year (6+3+3) general education system was introduced (i.e., 6 years of primary school, 3 years of lower secondary, and 3 years of upper secondary education). This system remains in effect today.

The current 12-year system means that it takes 12 years to complete general education comprising 6 years of primary school (Grades 1–6) and 6 years of secondary school (Grades 7–12), that is, 3 years of lower secondary school (Grades 7–9) and 3 years of upper secondary school (Grades 10–12), as shown in the figure below.

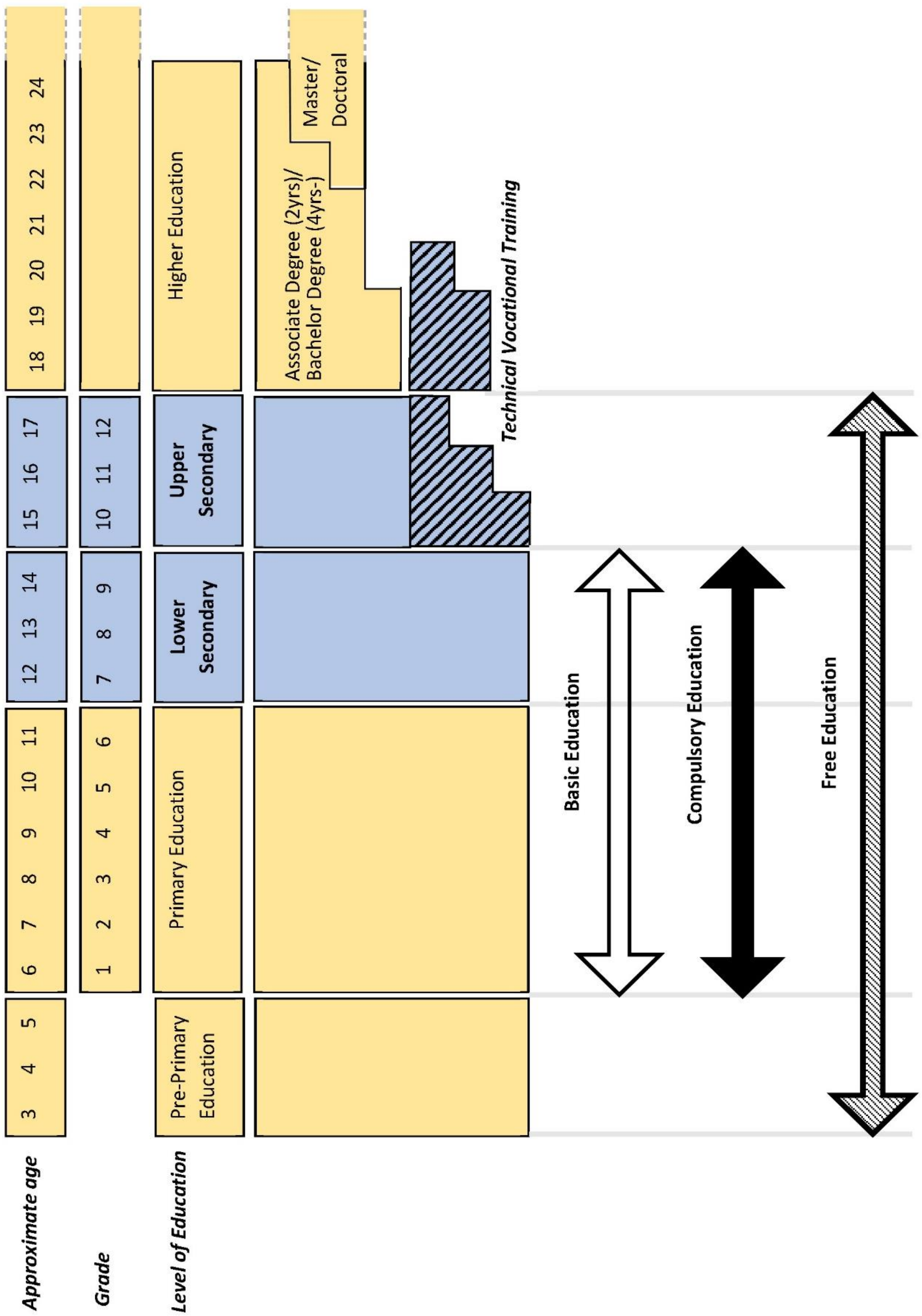


Figure 3.1: Education system in Cambodia (MoEYS)

In the academic year 2020–2021, there were 3,223,475 students enrolled in 13,597 public schools and 219,818 students enrolled in 1,307 private schools in Cambodia (MoEYS, 2021).

3.1.1 Technical vocational education in Cambodia

Technical vocational education and training (TVET) institutions prioritize specialised courses for the practical study of certain subjects, thereby enabling students to use their knowledge and practical abilities promptly after graduating and entering the workforce. Although the TVET system is distinct from general education at high school or university, it also offers a range of training courses from high school up to the master's degree level, with a number of majors (i.e., electronics, electricity, mechanics, civil engineering, IT, tourism, etc.).

Before 2004, TVET programs were governed by MoEYS, but when the Ministry of Labour and Vocational Training (MoLVT) was founded in 2004, control of TVET programs shifted to MoLVT. MoLVT offers training programs in non-formal systems, whereas MoEYS plays a role in providing technical education through formal schooling. MoEYS continues to oversee the provision of upper secondary TVE programs.

The National Technical Vocational Education and Training Policy 2017–202 (MoLVT, 2017) states that improving the skills of the current workforce and those who are prepared to enter the workforce is essential to Cambodia's status transition from a low-income country to a lower middle-income country. As shown in the graph below, the number of low-skilled employees is expected to decline, and the number of medium- and high-skilled workers is expected to rise.

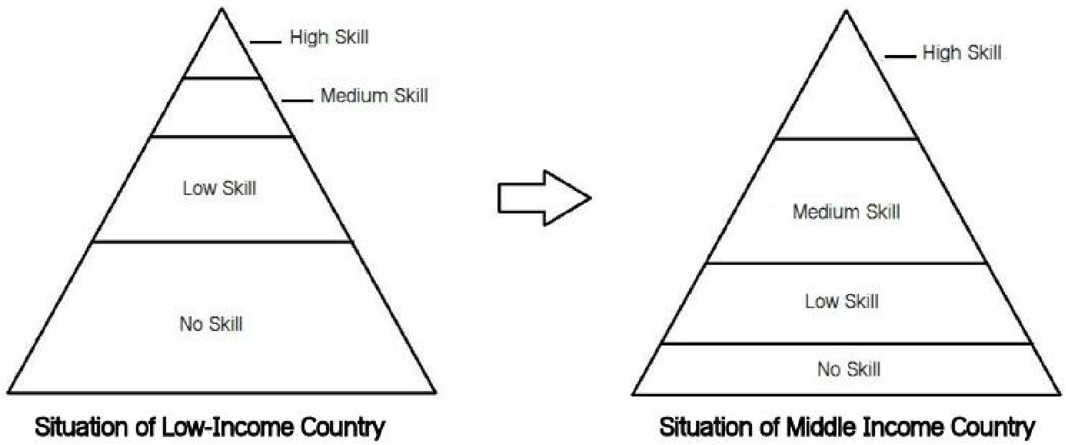


Figure 3.2: Situation of low-income and middle-income country (MoLVT, 2017)

3.1.1.1 Formal and informal TVET

Both formal and informal education are available in vocational programs in Cambodia. The MoLVT directly supervises formal TVET. Three official TVET education programs are available: the TVET program, the vocational diploma, and the university-level TVET program. These are long (2–4 years) programs that call for several credentials as prerequisites. Students must have at least finished lower secondary school in order to enrol in the TVET program. General, agricultural, IT, and electrical, computer, and civil engineering are just a few of the many fields/disciplines that may be studied.

Completion of a general upper secondary or vocational upper secondary is required for eligibility for a vocational diploma. The diploma is in the same field of study as the TVET program but adds business-related courses such as marketing and accounting. After completing the program, students can enrol in a vocational bachelor's degree program to become eligible for undergraduate programs with an emphasis on technology. Last but not least, one must have a vocational diploma or a general upper secondary diploma before enrolling in a TVET program at the postsecondary level. At this level of schooling, the emphasis is on developing industry-relevant skills. The knowledge and abilities that prepare students for their future professional path in the workforce include engineering, applied science, health science, and information and communication technology (ICT).

Provincial training centres (PTCs) and vocational training centres are the major providers of informal TVET (VTCs). Nongovernmental organizations and community learning centres (CLCs) also provide informal TVET. Training is usually short-term, with a duration of 1–4 months. The course primarily provides instruction in agriculture, construction, automobile repair, fundamental vocational skills, and fundamental food processing. Informal TVET lacks a suitable structure and a set of rules. The various training institutes offer different programs and have different training durations and enrolment levels. As of 2020, there were 157 CLCs in Cambodia striving to support the creation of human resources through informal TVET programs. Four informal TVET initiatives are supported by training grants (2009–2019), namely the National Training Fund, the Voucher Skills Training Program (VSTP), the Prime Minister's special fund known as The Special Fund of the Samdech Techo Prime Minister, and the Post-Harvest Technology and TVET Skills Bridging Program.

MoEYS' public TVE programs offer training at three distinct sublevels of the upper secondary level: Level 1 (1 year), Level 2 (2 years), and Level 3 (3 years). Private sector enterprises provide vocational training ranging from a duration of a few months to 3 years. Level 1 corresponds to 1-year program, level 2 to 2-years program, and level 3 to 3-years program. Students must possess a lower secondary certificate in order to enrol in these programs. This certificate is given upon successful completion of the lower secondary education test in Grade 9. Students who complete Level 3 TVE programs, which are regarded as being similar to upper secondary education, earn a MOEYS certificate that is equivalent to a bachelor's degree (Grade 12). With this certificate, students can enrol in TVE institutions for undergraduate degrees, which may be up to 4 years in duration to earn a bachelor's degree in technology, for example, or 2 years for an associate degree. Qualifying students may also enrol at related universities with permission from the Cambodian Accreditation Committee (ACC). As of 2019, there were 2,717 TVE students (MoEYS, 2019).

To encourage students who drop out before upper secondary school to return to school in order to obtain better and higher-paying employment, MoEYS has established the Skill Bridging Program. The skill bridging initiative focuses on students who leave school between Grades 7 and 9.

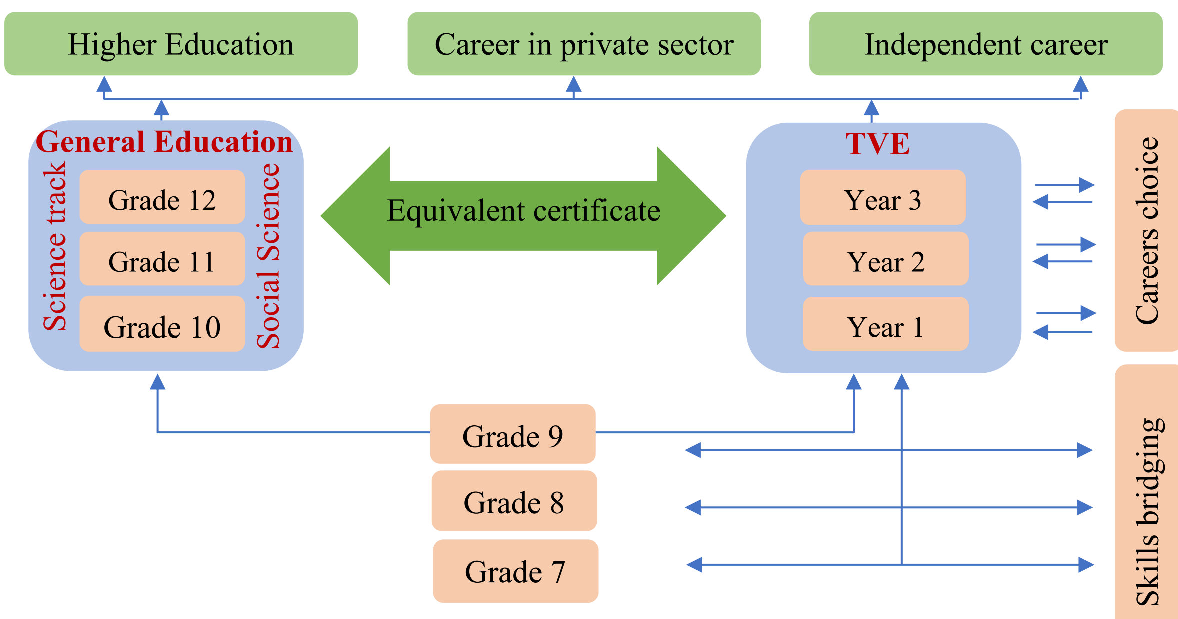


Figure 3.3: TVE of MoEYS

Currently, Cambodia's TVET certification system under MoLVT has eight levels, starting at Level 1, where students can earn a vocational certificate by taking informal courses or by demonstrating prior knowledge or skills. Cambodia's certification framework has both lateral and vertical paths connecting TVET and general education (UNESCO, 2019). Almost 70,000 students are enrolled in the 104 institutions listed under MoLVT, comprising 37 public institutions, 41 private institutions, and 26 non-governmental organizations, that offer technical and vocational training in 25 provinces.

Table 3.1: Level TVET qualification and general education

Level	TVET	General Education
1	Vocational Certificate	Lower Secondary
2	Technical and Vocational Certificate I	Upper Secondary
3	Technical and Vocational Certificate II	
4	Technical and Vocational Certificate III	
5	Higher Diploma/Associate Degree Of Technology/Business Education	
6	Bachelors in Technology / Business Education	Bachelors
7	Masters in Technology / Business Education	Masters
8	Doctorate in Technology/ Business Education	Doctorate

3.2 Career guidance in Cambodia

Currently, general education (Grades 10–12) and TVE are the two options for secondary education in Cambodia (Years 1–3). Students who choose general education as their secondary education path must select either the science or the social science track. TVE students must select one technical vocational skill from among those that have been trained in pertinent general high school and technical areas, such as mechanics, electronics, electricity, computers, agrology, aquaculture, finance, digital media design, food processing, tourism, etc.

To provide TVE in the medium and short term, expand the vocational orientation service, and improve the operation of the life skills program and the elective vocational education program in schools at all levels, MoEYS established the Vocational Orientation Department. Additionally, the Department ensures that students can access resources to pursue a vocational orientation and that they are prepared—that is, they possess the fundamental know-how and abilities needed—to find employment or continue their studies.

Despite the fact that MoEYS has created several rules, guidelines, and training programs, implementation of career guidance at the school level remains ineffective.

3.3 STEM and non-STEM careers

STEM occupations may be summarized as any professions or vocations in the disciplines of science, technology, engineering, and math. Both the commercial and public sectors offer STEM employment. However, there are other classifications of STEM occupations in keeping with the environment in industrialized and developing nations. Based on a synthesis of two pertinent materials in Cambodia, namely the STEM career brochure published by MoEYS and the British Embassy in Cambodia and the STEM majors list, the researcher categorized STEM and non-STEM professions in this study according to the context of Cambodia as a developing country (Kao, 2021). Since STEM has not yet been widely introduced in Cambodia and given that Cambodia is still a developing country, this study could not apply the term ‘STEM occupations’ to mean professional scientists. If the study had used that definition, the results would have differed or been biased because the respondents would not have interpreted the term to mean professional scientists or someone possessing advanced professional skills in science, technology, engineering, and mathematics.

3.4 Gender gap and key reasons for females' STEM involvement

The McKinsey Global Institute tracked 15 measures of gender equality in 95 countries and found that 40 of those countries had high or very high levels of gender discrimination across at least 50% of the metrics. Four categories of indicators have been established: professional equality, significant services related to and promoters of economic opportunity, legal protection for and the political freedom of speech, and physical security and sovereignty (McKinsey Global Institute & Devillard et al., 2015).

In growing economies such as Cambodia, where only 8.5% of the students enrolled in IT-related post-secondary programs are females, the significant lack of women is being felt. The same impediments affect women in technology-related businesses across all nations. Additional pressure and institutional and societal restrictions may prevent young women from pursuing career advancement in technology in Cambodia (Tsang & Poum, 2018).

A striking global example is the lack of both younger and older females in STEM (Burke & Mattis, 2007; Ceci et al., 2009; Ceci & Williams, 2011; Cheryan et al., 2017; Stoet & Geary, 2018). Women are significantly underrepresented in STEM-related occupations, and their proportions do not accurately reflect the overall number of female workers. Hence, women are mostly choosing careers outside of STEM (Beede et al., 2011; Gilbreath, 2015).

The American Association of University Women (AAWU) recommends that, in order to close the gender gap in STEM, both young and older females should be imbued with the confidence and skills necessary to succeed in mathematics and science classes, and STEM education for young women should be improved beginning in primary school and continuing through Grade 12. Further college women should be encouraged to major in STEM fields, and employers should hire and retain females with STEM undergraduate and graduate-level majors in STEM fields.

One of the objectives of the MoEYS STEM education policy is to encourage female students to pursue studies and conduct research in STEM fields because the proportion of female STEM teachers and students is still low when compared to the proportion of male STEM teachers and students (MoEYS, 2016).

The following are the main justifications for why women need to be involved in STEM fields.

a. By exchanging scientific knowledge, expertise, and technological advancements with other ASEAN nations, Cambodia has greatly developed and can continue to develop its human resources in preparation for ASEAN integration (Teacher & Law, 2013).
b. New occupations will be created as society quickly transitions from a conventional society to a high-tech environment.
c. The policies of the World Health Organization (WHO) and the Organisation for Economic Cooperation and Development (OECD) support female leadership as an adjunct to Sustainable Development Goal (SDG) 5 (Gender Equality).
d. In the future, the majority of occupations will be in STEM fields, and these will also be the highest paying occupations. According to the Pew Research Center, an

average STEM professional earns around 65% more money compared to any other occupation.

e. Around 50% global population are female, including over 50% of Cambodia's population.

f. According to research, increasing the number of women in STEM might result in an additional 12 trillion dollars in the global GDP by 2025 (McKinsey Global Institute & Devillard et al., 2015).

g. In addition to boosting the global economy, women offer science a perspective that men are unable to bring. Therefore, increasing the number of women in STEM can improve security and quality of life for both genders.

3.5 Factors affecting females' STEM career choice

Numerous studies on STEM career aspirations have included gender as a key component of their findings (Archer et al., 2014; Eccles, 1994; Hemandez-Martinez et al., 2008; Holmes et al., 2018; Novakovic & Fouad, 2013; Packard & Nguyen, 2003; Sadler et al., 2012; Shapka et al., 2006; Watt et al., 2012).

Consideration should be given to reporting the significant perceptual, motivational, and societal variables, particularly by expanding the range of career options that women view as feasible and well-matched with their talents, experience, preferences, and goals. Numerous women with a mathematics aptitude face career choice obstacle due to societal constraints, gender discrimination, and a lack of knowledge. Therefore, the purpose of this study was to broaden women's career options through utilization of their cognitive strengths, emphasizing effort and support over talent, encouraging women to focus on math and science, and eradicating male preconceptions and knowledge gaps that may limit career options (Wang & Degol, 2017).

Thanks to a variety of academic and extracurricular influences, women are being encouraged now more than ever to choose STEM careers. Inequality, favouritism, hostile campus cultures, shaky identities, and a tenuous sense of belonging are still barriers to successful degree completion and career entry, according to reports from students' everyday lives. In addition to these challenges, there exist a collective lack of care and a mentoring dearth (primarily regarding work–life stability) among female professors, leading to stress (Blackburn, 2017). In addition to the aforementioned obstacles, a variety of factors, such as social factors (Cho et al., 2009; Lyon & Lyon, 2013; Thackeray, 2016), rigid structures (Bottia et al., 2015), poor quality guidance, and others, have contributed to failings in employment labour (Wang & Degol, 2017) (Lee, 2008) and the primary school classroom atmosphere (Han, 2016). Nevertheless, research has revealed that connecting with STEM at an early age (Buschor et al., 2014; McCarthy & Berger, 2008), having caring relatives (Burge, 2013; Lee, 2016; Lyon, 2013;), access to value advice (Byars-Winston, 2014; Bystydzienski et al., 2015), and experience with gender-inclusive video games (Bonner, 2015; Borghetti, 2014; Gilliam et al., 2017) could play a role in choosing a profession before enrolling at a higher education institution (Blackburn, 2017).

These encounters point to a variety of factors, some in combination, including gender biases (Hill et al., 2010), a lack of female role models (Hill et al., 2010; Milgram, 2011), room for improvement in the STEM curriculum and the environment surrounding STEM instruction (Hill et al., 2010), and the perception that different STEM professions lack a common objective and opportunities for cooperative efforts (Buhrman, 2006; Diekman et al., 2010). These issues lead many women to decide that STEM is ‘not for them’ and choose alternative degrees and career paths (Zachmann, 2018).

3.6 Factors affecting students’ STEM career choices: Empirical evidence

Career options encompass a variety of fields and deciding is an intricate procedure. Individual and psychological elements comprise a factor’s initial level. Career interest is a predictor of both career preference and outcome (Nugent et al., 2015). Career interest is positively related to the decision to enrol in a course of study in a particular discipline (Hulleman et al., 2008). According to research conducted by the Organization for Economic Co-operation and Development (OECD) in 2005, students who show an interest in STEM subjects early in their schooling typically plan to take STEM subjects later. SCCT also explains that self-efficacy functions as a predictor of career interest (Fouad & Smith, 1996; Lent et al., 1994). How uniqueness affects performance in terms of choosing a vocation has been extensively examined (Holland, 1959; Seibert & Kraimer, 2001; Sullivan & Hansen, 2004). Moreover, Holland (1959) hypothesized that an individual’s career interests reveal who they are as a person. The idea suggests that uniqueness is a synthesis of several elements including skills, interests, actions, and ideals.

The impact of family support and views on STEM is considered significant as a result of the development of SCCT and its integration with social contextual elements (Lent et al., 2008). Parental influence was found to be a significant factor in the learner decision-making process (Workman, 2015). Numerous studies have detailed how parents' gender labelling and encouragement of gender-typed career decision making impact how female students view themselves and their competencies. These factors may be the cause of females’ lower-than-average global participation in STEM fields (Hartung et al., 2005; Tikly et al., 2018; Wang & Degol, 2017).

Third is schooling. Much research has examined the importance of educators and teachers in adolescent career decision making (Cheung & Arnold, 2014; Cheung et al., 2013; Howard et al., 2009; Yamashita et al., 1999). According to Cheung et al. (2013) and Howard et al. (2009) instructors 'are considered as prominent persons who are agents of growth and might have [an] effect on students' professional decision-making in both collectivist and individualistic societies. According to Cheung et al. (2013), students in Hong Kong judged their teachers' efficacy to be higher than that of their parents based on the parents' lower education levels. Additionally, Cheung and Arnold (2014) demonstrated that students trust their professors, peers, and parents in descending order of magnitude.

Environmental and sociological elements constitute the fourth significant aspect. Fouad et al. (2016) found that South Korean adolescents' occupation choices are influenced by social views and identified the effect of community responsibility as a key strength in adolescent career choice. Another study suggesting that social views influence adolescent career decision making in both collectivist and individualistic societies lends weight to those scholars' claims (Mau, 2004; Tao et al., 2018).

Numerous studies conducted in various contexts have identified a number of factors that affect female students' STEM career choices, but the problem of low STEM participation has not yet been resolved. Higher participation in STEM education towards a higher STEM career selection rate can be affected by encouraging women to engage in a variety of theoretical and extracurricular activities that promote gender equality in STEM education. To examine the factors influencing female students' STEM career choice, this study analysed the career development theories that are applicable to the Cambodian setting. Identifying the factors that affect interest in STEM will provide guidance for productive intervention and advance our knowledge of how STEM content is taught to students and how STEM career courses are established, both of which are important for promoting female participation in STEM in Cambodia and encouraging Cambodian women to choose STEM careers.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Overall design

This study had a quantitative design aimed at answering the two focused research questions. Applying this method, the researcher collected data using a survey questionnaire administered to upper secondary school students. Data pertaining to individual-level variables and demographic information, including family background, as well as school, the environment, and society, were collected. The advantage of a quantitative design is that it is the best method to gather the large amount of data necessary to perform statistical analyses and identify significant differences and predictors. Moreover, the study included relevant retrospective information; respondents had continuous records in key fields starting at the beginning of their lives. Furthermore, studies of this kind often collect information during and alongside parallel processes and at different levels.

4.2 Research sample and sampling method

Given that STEM has not been widely introduced in Cambodia and is not well-known among Cambodian teachers and students, this study encountered some high school teachers and twelfth graders who had never heard of STEM. The researcher carefully selected the sample to ensure that all respondents were familiar with STEM. The researcher purposely selected four different high schools in the Cambodian cities of Battambang and Phnom Penh. These cities were chosen because Phnom Penh is the capital of Cambodia and Battambang is Cambodia's third largest city and is set to be one of the 26 pilot cities in the ASEAN Smart Cities Network (ASCN), with various infrastructure projects slated for the province of Battambang. Due to time constraints on the research compounded with travel restrictions imposed during the Covid-19 pandemic, the researcher could not collect the data in person because the schools were closed. Since the number of schools and students in general education is far higher compared to TVET, twelfth graders at high schools in the two aforementioned cities who could access the Internet were selected to complete the survey. In total, 205 responses (79 from Phnom Penh and 126 from Battambang) were received, and of those, 183 were considered to be complete responses suitable for data analysis, as shown in Table 4.1. Females outnumbered males in the total research sample. The researcher could not control the gender ratio among the research subjects because it is based on the response rate to the questionnaire, which was distributed online.

Table 4.1: Details number of sample

School location	Number samples	male	female
Phnom Penh	79	13	66
Battambang	126	47	79
Total	205	60	145
Complete responds	183	54	131

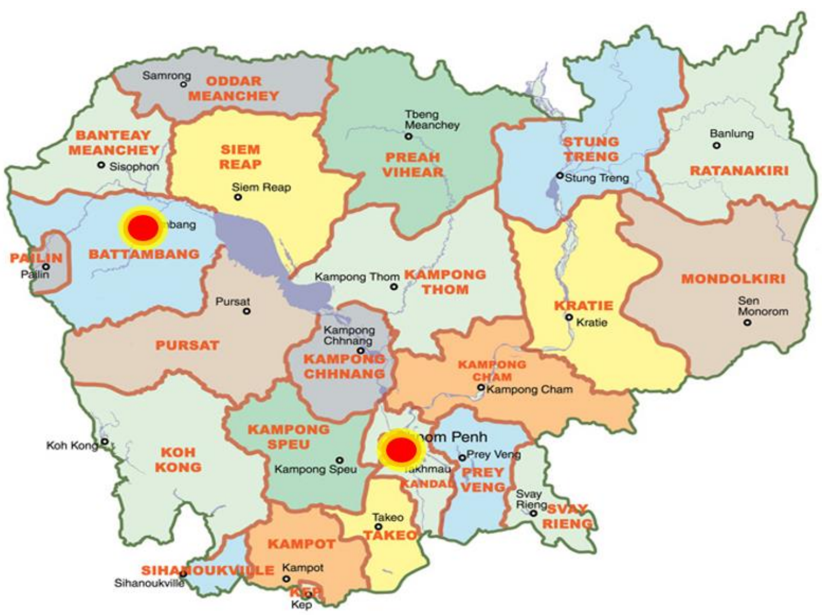


Figure 4.1: Location of selected provinces for the survey

4.3 Developing the instrument: A survey questionnaire for the target student population

4.3.1 Extant tools to measure STEM career choice

There are many existing empirical studies that have focused on the factors that influence students' career choice in STEM fields in both developed and developing countries. Most of those studies used a quantitative approach involving a survey questionnaire covering many variables representing factors affecting STEM students' career decision making, drawn from one, two, or all constructs of career development theories such as SCT, SCCT, and so forth. These studies focused on student interest as a factor that influences STEM career choice (Bynum & Varpio, 2018; Creswell & Poth, 2016). Some studies focused on peer influence using semi-structured questionnaires (Eccles et al., 1997; Wang & Eccles, 2012). However, since the modern world is facing the formidable challenge of the Covid-19 pandemic, the teaching/learning mode has had to be adapted accordingly. Therefore, the survey questionnaires used in previous studies were missing some relevant variables.

4.3.2 Tool development

The literature review was based on a search for research papers focusing on factors affecting students' STEM career choice, career development theories, non-traditional career choice and development, and the theoretical framework of career choice development. The search included ERIC, Google Scholar, and use of the terms 'factors influencing career choice and development', 'instrument for measuring factors affecting STEM career choice', 'social cognitive career theory and STEM'. The search period was the past 10 years. Specific subjects within STEM were also investigated to find literature involving the factors 'individual', 'family', 'school', and 'social'. The results of searching as described above suggested that there are many factors that influence STEM career choice including personal input, family and peers, school, environment, STEM self-efficacy, perception of STEM careers, and interest, which SCCT covers. The literature review and theoretical framework showed the progress of our preliminary survey items, along with other tools used to shape a theory on career choice and development among female construction professionals (e.g., Moore, 2006). The literature indicated the need for a survey instrument developed for Cambodia's context in light of the current STEM education situation, for use among a sample of Cambodian high school students.

The development of the survey drew on former instruments (Besigomwe, 2019; Halim et al., 2018; Kier et al., 2013; Mtemeri, 2017), together with a modified SCCT model used to test a portion of SCCT (Lent et al., 1994, 2000). This study also adopted the theoretical framework of a theory on career choice and development among female construction professionals (Moore, 2006). The researcher developed the variables based on the Cambodian context as well as those of other developing countries in light of the current STEM education situation. The research sample comprised Cambodian twelfth graders. SCCT was psychometrically assessed with respect to the factors expected to affect career choice and was employed in the design of the STEM career choice survey questionnaire developed in this study.

Preliminary survey items were created concerning each of the characteristics of SCCT. The researcher created a 110-item instrument, with five statements per SCCT characteristic. Based on advice from science educators, the researcher decided to use a 5-point Likert-type scale (where 1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*). The items were properly linked to all the characteristics of SCCT, and the survey questionnaire was understandable to upper secondary school students.

Some constructs and sub-constructs were adopted from previous studies, and some were newly developed by the researcher, as shown in detail in Table 4.2.

Table 4.2: Construct and Sub-construct of the questionnaire

Construct	Adaptation	Subconstruct	Example of Items
Family factors (15 Items)	*Constructed by researcher*	Gender role in family	My family members treat me the same as male siblings in the family
		Parents influences	My male guardian has influence in my choice of STEM as career
Individual factor (60 Items)	*Adopted from Meredith W. Kier, et al., 2013; Halim. L, et al., 2018*	STEM ability and achievement	I am able to get a good grade in my science class.
		STEM self-efficacy	I can obtain good grades in science subjects.
		Interest in a STEM career	I plan to use science in my future career.
School factor (20 Items)	*Constructed by researcher*	Activities outside the classroom	I join STEM related clubs in school.
		National career day	I attend National Career Day.
		Educational climate	Generally, teacher treat male and female students the same.
		Online learning	I can do better in science and mathematics when I have online classes.
Environmental and	*Adopted from Jeofrey*	Gender stereotype	Male students have higher career ambitions than girls.

sociological factor (15 Items)	*M.,2017 and constructed by researcher*	Role models and mentors	I have a female professional as my role model.
		Counselling and advising	Advice from others influenced my career choice in STEM.

A pilot test was run to check the reliability of the newly developed survey questionnaire. The pilot questionnaire was administered online to 205 twelfth graders from four high schools in the Cambodian province of Battambang and the city of Phnom Penh. Students were provided with a Google forms link to complete the survey. All respondents were consenting volunteers who had never seen the survey questionnaire before. Of the 205 responses received, 15 were removed because of incompleteness or duplication.

Cronbach's alpha was used to check the reliability (internal consistency), and data analysis comprised exploratory factor analysis. Acquiring the lowest number of explainable factors entailed describing the correlations among items using exploratory factor analysis to investigate the dimensionality of the instrument (McCoach et al., 2013). Cronbach's alpha values for each sub-construct of the survey items are shown in Table 4.3.

Table 4.3: Construct, sub-construct, and Cronbach alpha

Construct	**Sub-construct**	**Cronbach alpha**
Family	Gender equality	.779
	Guardian influence on STEM	.860
Individual	Science ability and achievement	.808
	Technology ability and achievement	.749
	Engineering ability and achievement	.871
	Mathematics ability and achievement	.831
	Science learning self-efficacy	.869

	Technology learning self-efficacy	.816
	Engineering learning self-efficacy	.749
	Mathematics learning self-efficacy	.823
	Interest in Science career	.850
	Interest in Technology career	.836
	Interest in Engineering career	.879
	Interest in Mathematics career	.822
School	STEM-related activities	.770
	Access to national career day	.863
	Teacher encouragement	.803
	Impact of online learning on STEM	.625
Environmental and sociological	Gender stereotype	.662
	Female role model	.720
	Advice for STEM career choice	.783

4.3.2.1 Content validity: Expert review

Content validity was ascertained to determine the extent to which the questionnaire items align with the four SCCT constructs. First, the content of the questionnaire was developed based on a literature review of existing theories and previous studies. Hence, the questionnaire content aligns with the findings of previous studies. Second, three researchers (two Cambodian researchers and one Japanese researcher) specialized in science education, physics education, and STEM reviewed all the survey items. Since the questionnaire was developed in English, to check the Khmer translation, the researcher had a Cambodian doctoral student at Hiroshima University read for accuracy and completeness. Last factor analysis was also employed to check the content validity of the items loaded into one group based on each factor's sub-construct.

4.3.2.2 Item reliability: Factor analysis results

Exploratory factor analysis draws a huge set of variables and seeks a way in which the data may be eliminated or shortened by applying a reduced set of factors or elements. It does this by looking for bunches or clusters with inter-correlations in a group of variables (Pallant, 2011). In this study, exploratory factor analysis was used to examine the internal structure of a set of 110 items and validate the sub-constructs underlying four main constructs, namely family, the individual, school, and environmental and sociological factors. The constructs in the study were developed based on SCCT, a literature review on the factors affecting students' STEM career choices, and content validity as assessed by STEM experts. This study initially did not extend the analysis to the level of confirmatory factor analysis as the study only aimed to explore the sub-constructs underlying the identified constructs in the process of developing an instrument. Based on statistical reliability and exploratory factor analysis, some items were deleted because of low factor loadings (< .400); this was done to increase reliability. Items with a Cronbach's alpha higher than .6 have acceptable reliability. As shown in the statistical results given in the tables below, the constructs and sub-constructs are displayed with their factor loadings and Cronbach's alpha values. For the factor 'family', there were originally 15 items, but three were deleted because their factor loadings were lower than .4; this was done to increase the sub-constructs' Cronbach's alpha values. Based on factor analysis, two sub-constructs were created/renamed: 'gender equality' and 'guidance influence in STEM'. As with the family factor, 7 of 60 items were deleted because of their factor loadings. The 'individual' factor was divided into 12 novel sub-factors: science ability and achievement, technological ability and achievement, engineering ability and achievement, mathematics ability and achievement, science learning self-efficacy, technological learning self-efficacy, engineering learning self-efficacy, mathematics learning self-efficacy, interest in a science career, interest in a technology career, interest in an engineering career, and interest in a mathematics career. Among the 20 items related to the 'school' factor, four were deleted for the same reason as previously mentioned (factor loadings based on statistical analysis). Four sub-factors were introduced: STEM-related activities, access to national career day, teacher encouragement, and the impact of online learning on STEM. Finally, regarding environmental and sociological factors, 4 of 15 items were deleted, and three sub-factors were added: gender stereotypes, female role model, and advice for STEM career choice.

Table 4.4: Result of factor loading and Cronbach's alpha for family factor 12 items (15 items, 3 items deleted)

Statement	**Loading**	**Factor**	**α**
Q2.10.1 My family members treat me the same as male siblings in the family.	.789	*Gender equality*	.779
Q2.10.2 My relatives treat me the same as male siblings in the family.	.799		
Q2.10.3 I have an equal opportunity to go to school and choose a major I like as my male sibling.	.782		
Q2.10.4 I have an equal opportunity to choose my career as my male sibling.	.732		
Q2.11.1 My male guardian has influence in my choice of STEM as career	.697	*Guardian influence on STEM*	.860
Q2.11.2 My female guardian has influenced my choice of STEM as a career.	.746		
Q2.11.3 My male guardian encourages me to choose a career in STEM.	.765		

Q2.11.4 My female guardian encourages me to choose a career in STEM.	.738		
Q2.11.7 My male guardian's career had an impact on my choice of career in STEM.	.685		
Q2.11.8 My female guardian's career had an impact on my choice of career in STEM.	.664		
Q2.11.9 Information I got from my male guardian helped me to choose a career in STEM.	.678		
Q2.11.10 Information I got from my female guardian helped me to choose a career in STEM.	.709		

Table 4.5: Result of factor loading and Cronbach's alpha for individual factor 53 items (60 items, 7 items deleted)

Statement	**Loading**	**Factor**	**α**
Q3.1a.3 I will work hard in my science class.	.764	*Science ability and achievement*	.808
Q3.1a.4 I like my science class.	.592		
Q3.1a.5 I take private class for science.	.834		
Q3.1b.1 I am able to do well in activities that involve technology.	.677	*Technology ability and achievement*	.749
Q3.1b.2 I am able to learn new technology.	.761		
Q3.1b.3 I will learn about new technologies that will help me with school.	.656		
Q3.1b.4 I like to use technology for class work.	.601		
Q3.1b.5 I am able to explain to others about technology.	.623		
Q3.1c.1 I am able to do well in activities that involve engineering.	.796	*Engineering ability and achievement*	.871
Q3.1c.2 I am able to learn new engineering.	.785		

Q3.1c.3 I will learn about new engineering that will help me with school.	.717		
Q3.1c.4 I like to use engineering for class work.	.818		
Q3.1c.5 I am able to explain to others about engineering.	.787		
Q3.1d.1 I am able to get a good grade in my Mathematics class.	.843	*Mathematics ability and achievement*	.831
Q3.1d.2 I am able to complete my Mathematics homework.	.823		
Q3.1d.3 I will work hard in my Mathematics class.	.400		
Q3.1d.4 I like my mathematics class.	.616		
Q3.3a.2 I can solve problems related to science concepts well.	.441	*Science learning self-efficacy*	.869
Q3.3a.3 I can write laboratory reports (experimental reports) correctly.	.772		
Q3.3a.4 I can collect information on science concepts properly.	.712		
Q3.3a.5 I am sure that I can carry out science experiments in the laboratory properly.	.652		
Q3.3b.1 I can download an image or video from the internet.	.686	*Technology learning self-efficacy*	.816
Q3.3b.2 I can handle everyday technological products easily (e.g., blender, microwave, toaster, rice cooker).	.754		
Q3.3b.3 I can use the computer properly.	.466		
Q3.3b.4 I can handle digital devices properly (e.g., smartphone, iPad, tablet).	.806		
Q3.3b.5 I can use social media properly (Facebook, Instagram, Twitter).	.790		
Q3.3c.1 I am sure that I can build a robot from Lego.	.518		.749

Q3.3c.2 I can use welding tools properly.	.761	*Engineering learning self-efficacy*	
Q3.3c.3 I can assemble furniture.	.730		
Q3.3c.4 I can build electronic circuits.	.706		
Q3.3c.5 I can repair a broken toy.	.698		
Q3.3d.1 I can obtain good grades in mathematics subjects.	.875	*Mathematics learning self-efficacy*	.832
Q3.3d.2 I am confident that I can record data accurately.	.575		
Q3.3d.3 I can draw a graph from the provided data.	.616		
Q3.3d.4 I am competent in using scientific calculators.	.520		
Q3.3d.5 I can solve mathematical problems properly.	.789		
Q3.4a.1 I plan to use science in my future career.	.714	*Interest in Science career*	.850
Q3.4a.2 If I do well in science classes, it will help me in my future career.	.637		
Q3.4a.3 I am interested in careers that use science.	.732		
Q3.4a.4 I would feel comfortable talking to people who work in science careers.	.734		
Q3.4b.1 I plan to use technology in my future career.	.690	*Interest in Technology career*	.836
Q3.4b.2 If I learn a lot about technology, I will be able to do lots of different types of careers.	.661		
Q3.4b.3 I am interested in careers that use technology.	.765		
Q3.4b.4 I would feel comfortable talking to people who work in technology careers.	.753		
Q3.4c.1 I plan to use engineering in my future career.	.769	*Interest in Engineering career*	.879
Q3.4c.2 If I learn a lot about engineering, I will be able to do lots of different types of careers.	.744		
Q3.4c.3 I am interested in careers that involve engineering.	.888		

Q3.4c.4 I would feel comfortable talking to people who are engineers.	.812		
Q3.4d.1 I plan to use mathematics in my future career.	.656	*Interest in Mathematics career*	.822
Q3.4d.2 If I do well in mathematics classes, it will help me in my future career.	.694		
Q3.4d.3 I am interested in careers that use mathematics.	.768		
Q3.4d.4 I would feel comfortable talking to people who work in mathematics careers.	.717		
Q3.4d.5 I know of someone in my family who used mathematics in their career.	.524		

Table 4.6: Result of factor loading and Cronbach's alpha for school factor 16 items (20 items, 4 items deleted)

Statement	**Loading**	**Factor**	**α**
Q4.1.1 I join STEM related clubs in school.	.663	*STEM related activities*	.770
Q4.1.2 I participate in a STEM festival.	.867		
Q4.1.3 I visited the STEM festival.	.807		
Q4.1.4 I participate in a STEM related competition.	.713		
Q4.1.5 I visit research centers at factories or at universities.	.567		
Q4.2.1 I attend National Career Day.	.781	*Access to national career day*	.863
Q4.2.2 I got a lot of information about my career on National career day.	.866		
Q4.2.3 I choose a career based on information I get from National career day.	.846		
Q4.2.4 National career day has influenced my career choice.	.796		
Q4.2.5 National career day is very useful.	.738		

Q4.3.1 Teacher actively encourages me to consider a wide range of career choices including those that are non-traditional.	.756	*Teacher encouragement*	.803
Q4.3.3 Generally, teachers treat male and female students the same.	.895		
Q4.3.4 Teacher expects the same achievement from females and males.	.885		
Q4.4.1 I can do better in science and mathematics when I have online classes.	.510	*Impact of online learning on STEM*	.625
Q4.4.2 I changed my career choice from non-STEM related to STEM because of online classes.	.918		
Q4.4.3 I changed my career choice from STEM to non-STEM related because of online classes.	.837		

Table 4.7: Result of factor loading and Cronbach's alpha for environment and sociological factor 11 items (15 items, 4 items deleted)

Statement	**Loading**	**Factor**	**α**
Q5.1.2 Male students have higher career ambitions than girls.	.773	*Gender stereotype*	.662
Q5.1.4 Women's role is homemaker and male's role are breadwinner.	.722		
Q5.1.5 Boys can use computers more effectively to solve problems than girls.	.826		
Q5.2.2 Female models have influenced me to choose the career I want to do.	.698	*Female role model*	.720
Q5.2.4 I have a female professional as my role model.	.845		
Q5.2.5 I have a female mentor to guide me for career choice.	.861		
Q5.3.1 I got advice from my teacher to choose a career in STEM.	.747	*Advice for STEM*	.783

Q5.3.2 I get advice from former students to choose a career in STEM.	.812	*career choice*
Q5.3.3 I get advice from my classmates to choose a career in STEM.	.753	
Q5.3.4 Advice from others influenced my career choice in STEM.	.696	
Q5.3.5 I chose a career in STEM by myself.	.650	

The four main constructs (family, individual, school, and environmental and sociological aspects) were developed based on SCCT, and sub-constructs were added (i.e., STEM-related activities, access to national career day, impact of online learning on STEM) to ensure that the survey questionnaire developed in this study would reflect the current global situation due to the Covid-19 pandemic and the resultant teaching/learning mode adaptation. This study did not initially extend the analysis to the level of confirmatory factor analysis as the study only aimed to explore the sub-constructs underlying the identified constructs in the process of developing an instrument.

Moore (2006) revealed that gender roles in family was found to influence and thus have the potential to support career choice across a variety of family backgrounds and demographics. Parental influence has also been found to shape students' aspirations to attend university (Lloyd et al., 2018).

When elementary and middle school students engage in discussions about their goals and the opportunities available in STEM, they have the time to connect their interests to STEM subjects and may demonstrate higher self-efficacy in these fields prior to college (Skamp, 2007). Career interest is known to be a predictor of both career preference and outcome (Nugent et al., 2015).

Due to the Covid-19 pandemic in 2020, close to half the world's students are still being impacted partially or fully by school closures (UNESCO, 2021). Therefore, online learning was introduced worldwide, and to reflect this, the sub-construct 'the impact of online learning on STEM' was added to the questionnaire developed in this study. This factor has the lowest reliability because it was newly introduced. Interestingly, this could indicate a scenario where students change their career choice much more easily from non-STEM to STEM, and vice versa. Cambodia's policy on STEM was initiated in 2016; therefore, many activities have been launched to promote interest in STEM. Hence, the factors 'STEM-related activities' and 'access to national career day' were included in the questionnaire to gather more information about students' interest in STEM in the context of developing countries where STEM may have been relatively recently introduced. For instance, the factor loading scores for STEM-related activities indicate that statements concerning attending and actively participating in STEM festival were well explained.

Gender has been an important point for many researchers who investigated STEM career choice (Eccles,1994; Packard & Nguyen, 2003; Shapka et al., 2006). Role models were found to be the greatest positive environmental influence on the decisions of women who work in the construction management field (Moore, 2006). Most previous STEM-related survey questionnaires focused on interest in a STEM career (i.e., Kier et al., 2013; Tyler-Wood et al., 2018), but only a few have focused on STEM career choice. The survey questionnaire developed in this study is different from existing surveys in that it measures the factors influencing students' STEM career choices and represents an attempt to provide updated measures for factors influencing upper secondary school students' STEM career choices in the setting of a developing country with a strong cultural influence and gender inequality, such as Cambodia. The instrument is easy to use and available online, meaning it is easy to implement in both formal and informal learning settings. This instrument includes a new variable under the 'school' factor based on the current global situation of the Covid-19 pandemic and the Cambodian context.

The instrument used in the current study covers both interpersonal and intrapersonal factors that influence career choice, in line with the findings of Tzu-ling (2019), Yu and Jen (2019), Bennet and Phillips (2010), and Jacobs et al. (2006). With an understanding of the factors influencing students' career choices, STEM educators can help students in their career decision making by guiding them to discover their value and benefit from their experiences.

4.4 Variables and measurements

4.4.1 Dependent variables

The dependent variable in the current study, referred to as 'students' career choice', was a dichotomous variable. The 'students' career choice' variable was coded as 1 = STEM career and 0 = non-STEM career. The variable was measured by asking students to indicate the career to which they aspire; the researcher then coded and grouped those careers into the two aforementioned categories (i.e., STEM or non-STEM). Given the variety of STEM and non-STEM careers based on the country context (i.e., given the variance in STEM and non-STEM career options between developed and developing countries), the researcher's career classification was tailored to suit the Cambodian context, i.e., developing countries. This was achieved based on synthesis of two relevant Cambodian official documents, namely the STEM career booklet published by MoEYS and the British Embassy in Cambodia and the list of STEM majors (Kao, 2021).

4.4.2 Independent variables

The independent variables were measures of the effects of the four push factors on students' career choice, which were classified into four levels: individual, family, school, and environmental and sociological.

4.4.2.1 Individual-level variables

In this study, there were 11 individual-level variables. The first three were ***gender*** (0 = female, 1 = male), ***whether there is an existing career plan at present*** (0 = no, 1 = yes), and ***upper secondary school stream*** (0 = social science, 1 = science). The remainder, all of which were scored on a 5-point Likert-type scale (where 1 = *strongly disagree*, 2 = *disagree*, 3 = *normal*, 4 = *agree*, 5 = *strongly agree*) were ***science ability and achievement***, ***technology ability and achievement***, ***engineering ability and achievement***, ***mathematics ability and achievement***, ***science learning self-efficacy***, ***technology learning self-efficacy***, ***engineering learning self-efficacy***, ***mathematics learning self-efficacy***, ***interest in a science career***, ***interest in a technology career***, ***interest in an engineering career***, and ***interest in a mathematics career***.

4.4.2.2 Family-level variables

The family variables were included ***order of childhood*** (0 = only child, 1 = the youngest, 2 = middle child, 3 = the eldest), ***type of guardian*** (0 = alone or no parent, 1 = parent), ***male guardian education*** (0 = no male guardian, 1 = no education, 2 = primary, 3 = lower secondary, 4 = upper secondary, 5 = bachelor's degree, 6 = master's degree, 7 = other), ***female guardian education*** (0 = no female guardian, 1 = no education, 2 = primary, 3 = lower secondary, 4 = upper secondary, 5 = bachelor's degree, 6 = master's degree, 7 = other), ***family income*** (1 = less than 200USD, 2 = 200–400USD, 3 = 400–600USD, 4 = over 600USD), ***gender equality in the***

family (1 = *strongly disagree*, 2 = *disagree*, 3 = *normal*, 4 = *agree*, 5 = *strongly agree*), and ***guardian influence on STEM*** (1 = *strongly disagree*, 2 = *disagree*, 3 = *normal*, 4 = *agree*, 5 = *strongly agree*).

4.4.2.3 School-level variables

This study had four school-level variables, including ***participation in STEM-related activities*** (1 = *never*, 2 = *sometimes*, 3 = *often*, 4 = *very often*, 5 = *always*). The remainder were scored on a 5-point Likert-type scale (where 1 = *strongly disagree*, 2 = *disagree*, 3 = *normal*, 4 = *agree*, 5 = *strongly agree*): ***access to national career day***, ***teacher encouragement***, ***impact of online learning on STEM***.

4.4.2.4 Environmental and sociological variables

These comprised three variables rated on a 5-point Likert-type scale where (1 = *strongly disagree*, 2 = *disagree*, 3 = *normal*, 4 = *agree*, 5 = *strongly agree*): ***gender stereotypes***, ***female role model***, and ***advice for STEM career choice***

Table 4.8: List of all variables discussed, specific items on the questionnaire, data type, and range of responses

Variables	Measures/Instruments	Data type	Range
Individual Factor			
Gender	Questionnaire Q1.2	Nominal	1-2
Whether there is an existing career plan at present	Questionnaire Q1.9	Nominal	1-2
Upper secondary School Stream	Questionnaire Q2.1	Nominal	1-2
STEM ability and achievement	Questionnaire Q3.1a.1-Q3.1d.5	Ordinal	1-5

STEM learning self-efficacy	Questionnaire Q3.2a.1-Q3.2d.5	Ordinal	1-5
Interest in STEM career	Questionnaire Q3.3a.1-Q3.3d.5	Ordinal	1-5
Family factor			
Order of childhood	Questionnaire Q2.3	Ordinal	1-4
Type of guardian	Questionnaire Q2.4	Nominal	1-2
Male guardian education	Questionnaire Q2.5	Ordinal	1-8
Female guardian education	Questionnaire Q2.6	Ordinal	1-8
Male guardian occupation	Questionnaire Q2.7	Nominal	1-2
Female guardian occupation	Questionnaire Q2.8	Nominal	1-2
Family income	Questionnaire Q2.9	Scale	1-4
Gender equality in the family	Questionnaire Q2.11.1-5	Ordinal	1-5
Guardian influence on STEM	Questionnaire Q2.12.1-10	Ordinal	1-5
School factor			
STEM-related activities	Questionnaire Q4.1.1-5	Ordinal	1-5
Access to national career day	Questionnaire Q4.2.1-5	Ordinal	1-5
Teacher encouragement	Questionnaire Q4.3.1-5	Ordinal	1-5
Impact of online learning on STEM	Questionnaire Q4.4.1-5	Ordinal	1-5
Environment and sociological factor			
Gender stereotype	Questionnaire Q5.1.1-5	Ordinal	1-5
Female role model	Questionnaire Q5.2.1-5	Ordinal	1-5
Advice for STEM career choice	Questionnaire Q5.3.1-5	Ordinal	1-5

4.5 Data collection procedure

Due to the Covid-19-related travel restrictions and school closures, the survey was administered online to 205 twelfth graders from selected high schools who had Internet access.

Participating students were sent a Google forms link to complete the survey. All respondents were consenting volunteers who had never seen the survey questionnaire before.

4.6 Data analysis

4.6.1 Data processing

Data processing entailed several steps prior to the main data analysis. As a first step after collecting the questionnaires, the researcher exported the data from Google forms and manually checked for completeness. To eliminate duplicates and incomplete questionnaires, responses containing no/missing information were discarded. The researcher then coded and cleaned the data in Microsoft Excel. Next, the researcher used descriptive statistics such as frequency, mean, and range to perform some preliminary checks on the data. This was done to ensure that there were no missing values or errors in the data input. The researcher imported the cleaned data into SPSS version 23. The researcher also carried out additional exploratory data analysis and calculated some additional descriptive statistics such as frequency, mean, and standard deviation. Exploratory factor analysis and reliability analysis were performed, and additional fundamental statistical hypotheses were applied and tested. Overall, the primary objective of the data processing procedure described above was to prepare a neat and complete dataset to support each research question's primary data analysis process.

4.6.2 Overall data analysis

Table 4.9 describes the overall analytical method and the expected result format for each research question.

Table 4.9: Research methods by specific research objectives

Research Questions	Research objectives	Specific research questions	Analytic methods	Expected forms of results to be presented
Research Question 1 (Finding I)	Factors affecting students' career choice (both male and female)	What are the factors influencing Cambodia upper secondary school students' STEM career choice?	Correlation Descriptive statistics Binary logistics regression	Table of statistical difference and significance on the factors explaining the career choice
Research Question 2 (Finding II)	Factors affecting female students' career choice	What are the most predictive factors influencing Cambodia upper secondary school female students' STEM career choice?	Correlation Descriptive statistics Binary logistics regression	Table of statistical difference and significance on the factors explaining the career choice

CHAPTER 5: FACTORS AFFECTING CAMBODIAN UPPER SECONDARY SCHOOL STUDENTS' STEM CAREER CHOICES: FINDING I

This chapter concerns the first research question, which is given below for ease of reference.

RQ1: What are the factors (individual, family, school, and environmental and sociological) influencing Cambodian upper secondary school students' STEM career choices?

5.1 Method for answering RQ1

5.1.1 Data analysis method

The current study's first objective was to examine the factors that explain Cambodian upper secondary school students' STEM career choices. Binary logistic regression makes use of one or more predictor variables that may be either continuous or categorical to predict the target variable classes. This technique helps to identify key factors (X_i) impacting the target variable (Y) and the nature of the relationship between each of these factors and the dependent variable (Patel, K., 2021). Since the outcome variable (dependent variable) was coded dichotomously, binary logistic regression was deemed to be a suitable analysis method to address RQ1 in order to assess the effects of the independent variables on the STEM career choices of Cambodian students in their last year of high school. To solve the problem, a block recursive model that makes specific assumptions about the causal order of individual, family, school, and environmental and sociological variables was used. Specifically, as explained in Table 5.1, the independent variables were entered into four 'blocks'.

Table 5.1: Methods of estimation for Finding I

Model	Block of independent variables included in the regression model
1	I (Individual Factor)
2	I (Individual Factor) + II (Family Factor)
3	I (Individual Factor) + II (Family Factor) + III (School Factor)
4	I (Individual Factor) + II (Family Factor) + III (School Factor) + IV (Environmental & Sociological Factor)

One can predict students' STEM career choices using a block recursive model by looking at the total effects of individual-level predictors (Model 1), as well as their net effects, when mediated by family-level predictors (Model 2), school-level predictors (Model 3), and environmental and sociological predictors (Model 4).

Due to the large volume of data, data reduction was considered since multicollinearity can cause great anxiety. Consequently, exploratory factor analysis using principal axis factoring with Varimax and Kaiser normalization in rotation was used to distinguish the constructs underlying the survey items as well as those underlying the item groups. This exploratory factor analysis is discussed in the measurement section of the study. Additionally, the four subjects were merged into STEM based on correlation analysis.

Moreover, although logistic regression was the primary analysis tool for answering RQ1, other analytical assessments were employed to determine the relationships among all variables. These tests were also utilized to ascertain whether the third variable had any bearing on why students chose certain careers. Collinearity statistical analysis in multiple regression was also carried out to prevent multicollinearity, and it was found that no variable had a tolerance value lower than .05 or a variance inflation factor (VIF) higher than 7 (Field, 2009).

Hence, multicollinearity was not considered to be an issue. The study employed logistic regression for the last stage of data analysis regarding RQ1, which was designed to identify the primary factors affecting the STEM career decision making of Cambodian upper secondary school students. The variables used in the binary logistic regression are listed in Table 5.2 by each block of components at the individual, familial, school, environmental and social levels. The analytical procedure considered both the current study's framework and the differences between various models. An advanced version of SPSS was used for the entire data analysis procedure in an attempt to answer RQ1.

Table 5.2: Variables included in the logistic regression model

Variables	**Definition/code**
Dependent	
Career Choice	0=non-STEM, 1=STEM
Independent	
Individual factors	
Gender	0=female, 1=male
Whether there is an existing career plan at present	0=no, 1=yes
Upper secondary School Stream	0=social, 1=science
STEM ability and achievement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
STEM learning self-efficacy	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Interest in STEM career	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Family factors	
Order of childhood	0=single child, 1=youngest, 2=middle, 3=oldest

Dummy type of guardian	0=alone or with non-parents,1=with guardian
Male guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Female guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Male guardian occupation	0= non-STEM, 1= STEM
Female guardian occupation	0= non-STEM, 1= STEM
Family income	1=Lower than 200, 2=200 to 400, 3=400 to 600, 4=Over 600
Gender equality in the family	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Guardian influence on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
School factors	
STEM-related activities	1=never, 2=sometime, 3=often,4=very often, 5=always
Access to national career day	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Teacher encouragement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Impact of online learning on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Environmental and sociological factors	
Gender stereotype	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

Female role model	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Advice for STEM career choice	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

5.2 Results for RQ1

5.2.1 Descriptive results

The frequency table for all the questionnaire items, indicating frequency, mean, and standard deviation of the computed variables included in the logistic regression, is given in the appendixes.

Table 5.3 presents descriptive statistics for the variables across the four dimensions used in the binary logistic regression, including mean [M], standard deviation [SD], and minimum and maximum. The descriptive statistics also revealed some essential assumptions related to particular pupils and the characteristics of the variables in other dimensions. First is the study's dependent variable, STEM career choice.

Table 5.3: Descriptive results of the variables included in the logistic regression model

Variables	**Mean**	**SD**	**Minimum**	**Maximum**
Dependent				
Career Choice	.49	.50	0	1
Independent				
Individual factors				
Gender (male=1)	.28	.45	0	1
Whether there is an existing career plan at present	.80	.40	0	1
Upper Secondary School Stream	.57	.49	0	1
STEM ability and achievement	3.36	.42	2.06	4.47

STEM learning self-efficacy	3.16	.43	2.05	4.37
Interest in STEM career	3.48	.52	1.71	4.94
Family factors				
Order of childhood	1.90	.87	0	3
Type of guardian	.84	.37	0	1
Male guardian education	2.72	1.64	0	6
Female guardian education	2.97	1.52	0	7
Male guardian occupation	.14	.35	0	1
Female guardian occupation	.04	.19	0	1
Family income	1.77	.99	1	4
Gender equality in the family	3.57	.66	1	5
Guardian influence on STEM	3.22	.47	2	5
School factors				
STEM-related activities	1.64	.60	1	4.25
Access to national career day	3.12	.75	1	5
Teacher encouragement	4.03	.66	1	5
Impact of online learning on STEM	2.65	.57	1	4.67
Environmental and sociological factors				
Gender stereotype	2.12	.73	1	5
Female role model	3.33	.65	1	5
Advice for STEM career choice	3.29	.56	1	5

5.2.2 Interpretation and overall model fit

Analysis by model (the individual-level factors model, the family-level factors model, the school-level factors model, and the environmental and sociolegal factors model) was conducted to better understand the factors affecting students' career choices. Given that the dependent variable was coded dichotomously, binary logistic regression with the enter method was used (0 = non-STEM career choice, 1 = STEM career choice). Three data reading techniques were implemented in this investigation to speed up interpretation of the logistic regression results. First, the -2log-likelihood statistic and its associated chi-square statistic were examined to determine whether the model was a good fit for the data. This can be ascertained using the Nagelkerke R-square or the Cox & Snell R Square analogue. In statistical terms, the proportion demonstrated the difference in the students' career choices as explained by a combination of factors under each main factor (i.e., individual, family, school, and environmental and sociological factors). The Cox & Snell R Square was employed to interpret the results of this study, since it was more reliable than its alternative. The Cox & Snell R Square was in the range 0–0.75, whereas the Nagelkerke R Square was in the range 0–1. Secondly, the researcher looked at the value of the coefficient (*B*) to determine the relationships between each variable that contributed to explaining the differences in the students' careers choices; interpretation was based on the numerical value and the sign orientation. For example, a negative coefficient in an equation where career choice was the referenced category denoted that individuals were more likely to choose a non-STEM career than a STEM career if the independent variables were greater, and vice versa. Thirdly, when exponentiated and deducted from 1, the coefficient or odds ratio *Exp(B*) was understood as a measurement of the change in odds brought about by a unit change in the predictor variables. In simple terms, it indicated how much each key predictor variable changed in relation to the probability that students would select a STEM occupation. The coefficient was transformed into percentage difference in likelihood using the method *[Exp(coefficient)-1] x 100* for ease of understanding.

We will now look at the general fit of the data to the model before delving more deeply into explaining each major variable. According to the logistics regression analysis results (Cox & Snell R Square = .267; see Table 5.4), the overall factors influencing the career choices of

Cambodian upper secondary students accounted for 26.7% of the variation in those decisions. Specifically, 16.4% (Cox & Snell R Square = .164) of the variation in the Cambodian upper secondary students' career choices can be explained by determinants at the individual-level. The variation impacting students' career choices increased to 23.4% (Cox & Snell R Square = .234) and 25.6% (Cox & Snell R Square = .256) for the individual component in the second and third regression models, respectively. The model's -2log-likelihood ratio was significant, as evidenced by the fact that the chi-square statistic was less than .05 (*p* =.000). Most importantly, the Hosmer and Lemeshow test chi-square value was higher than .05 ($p > .05$), indicating that the model was correctly specified. Based on the statistical findings, it was possible to conclude that the model significantly and successfully fit the data. The model testing results suggest, theoretically speaking, that the data are consistent with the application of the conceptual models that served as the conceptual foundation for the current investigation.

Table 5.4: Estimation results of upper secondary school students' STEM career choice

Significant Predictors	***Model 1***		***Model 2***		***Model 3***		***Model 4***	
	B(SE)	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***
Gender	.95(.47)*	2.58	.90(.47)	2.46	.69(.51)	1.99	.61(.55)	1.83
Upper Secondary School Stream	1.30(.43)**	3.68	1.62(.52)**	5.07	1.57(.54)**	4.79	1.67(.56)**	5.29
Cox & Snell R Square	.164		.234		.256		.267	
Nagelkerke R Square	.220		.313		.342		.357	

Note: * when $p < .05$; ** when $p < .01$; *** when $p < .001$

Secondly, Table 5.4 highlights the significant impact of sociological elements at the individual, family, school, and environmental levels on the career choices of Cambodian upper secondary school students. As the content of the table implies, the first model (for individual-level factors) showed estimates of the important variables' 'gender' and 'upper secondary school stream' when the other major factors were not considered. Thus, 16.4% of these variables' total variation with respect to students' career choices was explained (Cox & Snell R Square = .164). A single variable, upper secondary school stream, accounted for 23.4% of students' career choice in the second model (Cox & Snell R Square = .234). Upper secondary school stream was also significant in the third and fourth models, reaching 25.6% (Cox & Snell R Square = .256) and 26.7% (Cox & Snell R Square = .26.7), respectively.

5.2.3 Factors affecting students' STEM career choices

5.2.3.1 Individual-level factors

The logistic regression analysis results indicate that the individual-level factors strongly affected the Cambodian upper secondary school students' STEM career choices. Overall, the model explained 16.4% of the variation in students' career choices (Cox & Snell R Square = .164; see Table 5.5). The decision to enrol in a particular (STEM) discipline, attention to learning, individual character, and personal capacities, interest, habits, and principles are some of the important variables that survived in the model. It was found that Cambodian upper secondary school students' gender (Exp(B) = 2.59) and upper secondary school stream (Exp(B) = 3.69) strongly influenced their STEM career choice.

With reference to the influencing factors, male secondary school students were 2.59 times more likely to choose STEM careers than their female counterparts ((Exp(B)=2.59, $p < .05$). The expected value of male secondary school students who choose STEM careers was found to be statistically significant, with variation ranging from 1.02 to 6.53.

The second variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choices is upper secondary school stream ($p < .01$). It was found that students in the science stream/track were more likely to choose a STEM career than those in the social science stream/track. Specifically, a one-unit increase in positive STEM perception among students in the science stream increased the odds of choosing a STEM career by a factor of 3.69 (Exp(B)= 3.69). This expected value was revealed to be statistically significant ($p <.01$), with variation ranging from 1.57 at the lower bound to 8.65 at the upper bound of the 95% confidence interval (CI). Simply phrased, students who chose the science stream at the secondary school level had a 3.69 times greater probability of choosing a STEM career in the future than students in the social science stream.

Regarding the variables other than the two mentioned earlier, namely the existence of a career plan at the time of the survey, STEM ability and achievement, STEM learning self-effacement, and interest in a STEM career ($p > .05$), the present study found that these had no statistically significant influence on Cambodian upper secondary school students' STEM career choices.

Table 5.5: Individual-level factors influencing students' STEM Career choice

Model 1: Individual-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.40(1.86)*		.01	
Gender (Male=1)	.95(.47)*	1.02	2.59	6.53
Whether there is an existing career plan at present	.46(.58)	.51	1.60	4.97
Upper secondary school stream	1.30(.43)**	1.57	3.69	8.65
STEM ability and achievement	.25(.75)	.30	1.30	5.61
STEM learning self-efficacy	.06(.73)	.25	1.60	4.43
Interest in STEM career	.52(.56)	.56	1.69	5.06
Cox & Snell R Square	.164			

Nagelkerke R Square	.220

Note: * when p < .05; ** when p < .01; *** when p < .001

5.2.3.2 Family-level factors

As shown in Table 5.6, no variables among the family-level factors had a significant influence on Cambodian upper secondary students' STEM career choices because their *p*-values were higher than .05 ($p > .05$). However, the variables 'type of guardian', 'male guardian education', 'female guardian education', 'female guardian occupation', and 'parental influence on STEM' will be explained as these had Exp(B) values greater than 1.

Regarding the first variable, students living with their parents/guardians were 3.24 times more likely to choose a STEM career than students in different living arrangements. Regarding the second and third variables, students with parents/guardians with a higher education were 1.30 (male guardian education) and 1.04 (female guardian education) times more likely to choose a STEM career than students with parents/guardians with less education. Regarding the fourth variable, students with a mother who is a STEM professional were 5.17 times more likely to choose a STEM career than those whose mother is not a STEM professional. Regarding the last variable, students whose parents/guardians wanted them to choose a STEM career were 1.70 times more likely to do so than students whose parents/guardians did not express such a desire.

Table 5.6: Family-level factors influencing students' STEM career choice

Model 2: Family-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.47(2.57)		.01	
Order of childhood	- .25(27)	.46	.78	1.33
Type of guardian	1.17(.82)	.65	3.24	16.05

Male guardian education	.13(.18)	.80	1.30	1.60
Female guardian education	.04(.16)	.76	1.04	1.42
Male guardian occupation	- .82(.73)	.10	.44	1.83
Female guardian occupation	1.64(1.36)	.36	5.17	74.15
Family income	- .21(.27)	.48	.81	1.37
Gender equality in the family	- .54(.38)	.27	.58	1.22
Guardian influencing on STEM	.53(.53)	.60	1.70	4.77
Cox & Snell R Square	.234			
Nagelkerke R Square	.313			

5.2.3.3 School-level factors

Based on the logistic regression analysis results, school-level factors significantly influenced Cambodian upper secondary school students' STEM career choices. Overall, the model explained 25.6% (Cox & Snell R Square = .256) of the variance in students' career choices (see Table 5.5), but no statistical result showed the significance of the main variable classified as a school-level factor. However, the variables 'STEM-related activities' and 'teacher encouragement' had Exp(B) values greater than 1.

Students who were involved in STEM-related activities were 1.31 times more likely to choose a STEM career than students who were not involved in such activities. Moreover, students who received encouragement from their teachers were 1.64 times more likely to choose a STEM career than those who did not receive such support.

Table 5.7: School-level factors influencing students' STEM career choice

Model 3: School-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-5.98(2.89)*		.00	
STEM-related activities	.27(.51)	.48	1.31	3.60

Access to national career day	- .79(.50)	.17	.45	1.22
Teacher encouragement	.49(.42)	.72	1.64	3.75
Impact of online learning on STEM	- .07(.47)	.37	.93	2.34
Cox & Snell R Square	.256			
Nagelkerke R Square	.342			

Note: * when p < .05

5.2.3.4 Environmental and sociological factors

The environmental and sociological factors did not differ from the family-level factors. The former was also found to have no significant influence ($p > .05$) on Cambodian upper secondary school students' STEM career choices. This paper will not provide a detailed explanation of any of the variables classified as environmental and sociological factors as their Exp(B) values did not exceed 1.

Table 5.8: Environment and sociological-level factors influencing students' STEM career choice

Model 4: Environmental and sociological-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.16(3.22)		.02	
Gender stereotype	- .38(.37)	.33	.68	1.42
Female role model	- .30(.58)	.23	.74	2.32
Advice for STEM career choice	.19(.56)	.28	.82	2.47
Cox & Snell R Square	.268			
Nagelkerke R Square	.357			

5.3 Discussion of the results for RQ1 and derived conclusions

In line with previous studies (e.g., Armstrong et al., 2011; Kao & Kinya, 2020; Van Tuijl & Walma van de Model, 2016; Wangm & Degol, 2013), the present study found influential factors at the individual level. Being male was associated with higher STEM motivation. It was also noted that female students struggle to stimulate positive interest in STEM. Crowley-Long (2003) and Lengermann and Wallace (2005) also revealed that gender is often linked to certain stereotypical career roles. Male students normally have higher senses of social belonging and personal ability as well as higher self-efficacy than female students pursuing STEM courses (Ito & McPherson, 2018). Regarding cultural stereotypes, females tend to be perceived as less adept at math and science than males (Nosek et al., 2002; Robinson-Cimpain et al., 2004). The present study found a 2.59 times greater likelihood of choosing a STEM career among male students (per one unit). In the Cambodian context, which is a society with a strong cultural influence, males are more highly valued than females. Most female professionals work in administration and finance. Through development strategies, the government has tried to encourage and support more females in leadership and technical fields. Ultimately, male students are more likely than female students to choose STEM careers.

Another influential factor consistent with prior studies (e.g., Darolia et al., 2018; Kao, 2021; Kwak, 2009; Shin et al., 2017; Shin et al., 2018) is academic performance in science subjects. Secondary school students in the science stream have a good academic performance and are confident that they will continue to perform well in science subjects. It was found that a one-unit increase in this expectation regarding science stream students led to a 3.69 times greater likelihood of choosing a STEM career. Kao (2021) showed a significantly sharpened decline in the number of students who study science due to students' preoccupation with passing the national exam in Grade 12. Students believe that, on the social science track, they will have a higher chance of passing the exam and getting better grades, mainly because of the status of their academic achievement in science and mathematics and in the interest of their academic achievement in general. Hence, students whose performance was low who aim to pass the national examination tend to choose the social science track, where they are not required to take all the science courses or attempt the difficult mathematics tests comprising the baccalaureate examination. This implies that students who perform poorly in science and have low STEM self-efficacy drive the trend of declining STEM career selection as they are more likely to choose a non-STEM career.

Based on the above, the most influential factors affecting upper secondary school students' STEM career choices are individual factors because males are more valued in terms of studying science, so they can perform better in science courses than female students.

CHAPTER 6: FACTORS AFFECTING CAMBODIAN UPPER SECONDARY SCHOOL FEMALE STUDENTS' STEM CAREER CHOICES: FINDING II

This chapter concerns RQ2, which is given below for ease of reference.

RQ2: What are the factors (individual, family, school, and environmental and sociological) influencing Cambodian upper secondary school female students' STEM career choices?

6.1 Method for answering RQ2

6.1.1 Data analysis method

The present study's second goal was to investigate the variables that contribute to Cambodian female upper secondary school students' selection of STEM careers. The study's second goal is comparable to the first, except the researcher excluded males from the analysis. To predict the target variable classes, binary logistic regression uses one or more predictor variables that may be continuous or categorical. This method aids in identifying significant variables (X_i) that have an influence on the target variable (Y) as well as the nature of their interactions with the dependent variable (Patel, K., 2021). Hence, binary logistic regression was deemed an appropriate analytical technique to answer the second research question, which concerns the impact of the independent variables on the STEM career choices of Cambodian female students in their senior year of high school. A block recursive model that makes precise assumptions about the causal relationship between variables at the individual, family, school, and environmental and social levels was utilized. In particular, the independent variables were placed into four 'blocks', as detailed in Table 6.1.

Table 6.1: Methods of estimation for Finding II

Model	Block of independent variables included in the regression model
1	I (Individual Factor)
2	I (Individual Factor) + II (Family Factor)
3	I (Individual Factor) + II (Family Factor) + III (School Factor)
4	I (Individual Factor) + II (Family Factor) + III (School Factor) + IV (Environmental & Sociological Factor)

The total effects of individual-level predictors on female students' decision to pursue a STEM career (Model 1), the net impacts of individual-level factors as mediated by family-level predictors (Model 2), the effects of school-level predictors (Model 3), and the effects of environmental and sociological-level predictors (Model 4) were all identified using a block recursive model.

Data reduction was performed, in addition to the primary analysis, because the data comprised a sizable number of elements, where multicollinearity might be quite frightening. For this reason, main axis factoring with Varimax and Kaiser normalization in rotation was employed in an exploratory factor analysis of the survey items; this was done to distinguish the components underlying the set of items. The study's measuring section on measurements lists the variables identified in the exploratory factor analysis results. Additionally, correlation analysis was performed to combine the four disciplines into STEM.

The associations between all factors were also determined, as well as whether the third variable had any bearing on how female students chose a career, even though logistic regression was the primary analytical technique for answering RQ1. Collinearity statistical analysis in the multiple regression was also carried out to prevent multicollinearity, and it was found that no variable had a tolerance 108 statistic lower than .05 or a VIF higher than 7 (Field, 2009). Hence, multicollinearity was not a problem.

The study employed logistic regression for the final step of data analysis pertaining to RQ2, which was designed to identify the primary variables impacting Cambodian female upper secondary school students' decision to pursue a STEM career. The variables used in the binary logistic regression analysis are listed in Table 6.2 by each block of components at the individual, family, school, and environmental and social levels. In essence, the analytical approach considered the current study's framework as well as the differences between the different models. An advanced version of SPSS was used for the whole data analysis procedure in an attempt to answer RQ2.

Table 6.2: Variables included in the logistic regression model

Variables	**Definition/code**
Dependent	
Career Choice	0=non-STEM, 1=STEM
Independent	
Individual factors	
Whether there is an existing career plan at present	0=no, 1=yes
Upper secondary School Stream	0=social, 1=science
STEM ability and achievement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
STEM learning self-efficacy	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Interest in STEM career	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Family factors	

Order of childhood	0=single child, 1=youngest, 2=middle, 3=oldest
Dummy type of guardian	0=alone or with non-parents,1=with guardian
Male guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Female guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Male guardian occupation	0= non-STEM, 1= STEM
Female guardian occupation	0= non-STEM, 1= STEM
Family income	1=Lower than 200, 2=200 to 400, 3=400 to 600, 4=Over 600
Gender equality in the family	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Guardian influence on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
School factors	
STEM-related activities	1=never, 2=sometime, 3=often,4=very often, 5=always
Access to national career day	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Teacher encouragement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Impact of online learning on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Environmental and sociological factors	
Gender stereotype	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

Female role model	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Advice for STEM career choice	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

6.2 Results for RQ2

6.2.1 Descriptive statistics

Table 6.3 displays the descriptive statistics for the four dimensions of variables used in the binary logistic regression, including mean [M], standard deviation [SD], and minimum and maximum. The descriptive statistics also revealed some fundamental conclusions regarding particular pupils and the traits of the variables in the other dimensions. First is the study's dependent variable, STEM career choice.

Table 6.3: Descriptive results of the variables included in the logistic regression model

Variables	Mean	SD	Minimum	Maximum
Dependent				
Career Choice	.46	.50	0	1
Independent				
Individual factors				
Whether there is an existing career plan at present	.83	.37	0	1
Upper Secondary School Stream	.58	.49	0	1
STEM ability and achievement	3.38	.37	2.65	4.47
STEM learning self-efficacy	3.16	.43	2.21	4.37
Interest in STEM career	3.50	.51	2.24	4.94
Family factors				
Order of childhood	1.88	.88	0	3
Type of guardian	.85	.36	0	1

Male guardian education	2.76	1.54	0	6
Female guardian education	2.90	1.49	0	7
Male guardian occupation	.14	.35	0	1
Female guardian occupation	.04	.21	0	1
Family income	1.73	.96	1	4
Gender equality in the family	3.58	.68	1	5
Guardian influence on STEM	3.20	.42	2	4.25
School factors				
STEM-related activities	1.68	.62	1	4.25
Access to national career day	3.20	.74	1	5
Teacher encouragement	4.04	.66	1	5
Impact of online learning on STEM	2.66	.60	1	4.67
Environmental and sociological factors				
Gender stereotype	2.06	.73	0	1
Female role model	3.44	.58	2.33	5
Advice for STEM career choice	3.32	.52	1.22	5

6.2.2 Interpretation and overall model fit

Analysis by model (the individual-level factors model, the family-level factors model, the school-level factors model, and the environmental and sociological factors model) was performed to better understand the variables influencing female students' career choices. Given that the dependent variable was coded dichotomously, binary logistic regression using the enter method was used (0 = non-STEM career choice, 1 = STEM career choice). Three data reading strategies were used in this study to speed up interpretation of the logistic regression results. First, the -2log-likelihood statistic and its associated chi-square statistic were analysed to determine whether the model was a significant match for the data. This can be ascertained using the Nagelkerke R-square or the Cox & Snell R Square analogue. In statistical terms, the resultant percentage showed how much of the variation in the female students' career choices could be explained by a combination of factors under each major component (i.e., individual, family, school, and environmental and sociological factors). The Cox & Snell R Square was used to interpret the results of this study, since it is more reliable than its alternative. The Cox & Snell R Square was in the range 0–0.75, whereas the Nagelkerke R Square was in the range 0–1. Secondly, the researcher looked at the value of the coefficient (*B*) to determine how each variable related to the others in terms of explaining the variation in the female students' career choices. Interpretation was based on the numerical value and the sign orientation. For example, a negative coefficient in an equation where career choice was the referenced category denoted that students were more likely to select a non-STEM career than a STEM career if the independent variables were greater, and vice versa. Thirdly, when exponentiated and deducted from 1, the coefficient or odds ratio *Exp(B)* was understood as a measure of the change in odds brought about by a unit of change in the predictor variables. In simple terms, it demonstrated how much each key predictor variable changed in relation to the likelihood of female students choosing a STEM career. The coefficient was transformed into percentage difference in likelihood using the method *[Exp(coefficient)-1] x 100* for easy comprehension.

Let us look at the general fit of the data to the model before delving more deeply into explaining each major variable. According to the logistics regression analysis results, the factors that contributed to the career choices of Cambodian female upper secondary students all together explained 33.1% of the variation in those decisions (Cox & Snell R Square = .331; see Table 6.4). Specifically, individual-level variables explained 23.6% (Cox & Snell R Square = .236) of the variation regarding the career choice of female upper secondary students in Cambodia. The proportion of the variation impacting the female students' career choice grew to 30.8% (Cox &

Snell R Square = .308) and 31.3% (Cox & Snell R Square = .313) in the second and third regression models, respectively. The model's -2log-likelihood ratio was significant, as evidenced by the fact that the chi-square statistic was below .05 (p = .000). Most importantly, the Hosmer and Lemeshow test chi-square value was higher than .05 (p >.05), indicating that the model was correctly specified. Based on the statistical findings, it was possible to conclude that the model significantly and successfully fit the data. The model testing results suggest, theoretically speaking, that the data are consistent with the application of the conceptual models that served as the conceptual foundation for the current investigation.

Table 6.4: Estimation results of upper secondary school female students' STEM career choice

Significant Predictors	***Model 1***		***Model 2***		***Model 3***		***Model 4***	
	B(SE)	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***
upper secondary school Stream	1.86(.57) ***	6.41	2.64(.78) ***	14.06	2.63(.83) **	13.88	3(.92) ***	20.15
Interest in STEM career	1.67(.80) **	5.30	2.02(.93) **	7.54	2.18(.98) **	8.87	2.20(1.10) *	8.99
Cox & Snell R Square	.236		.308		.313		.331	
Nagelkerke R Square	.317		.414		.421		.446	

Note: * when p < .05; ** when p < .01; *** when p < .001

Secondly, Table 6.4 highlights the significant impact of sociological factors at the individual, family, school, and environmental and sociological levels on the career choice of Cambodian female upper secondary school students. As the content of the table implies, the first model (for individual-level factors) showed estimates of the significant variables 'upper secondary school stream' and 'interest in a STEM career' when the other major factors were not considered. In terms of these, the overall variation these explained in the female students' occupational choice was 23.6% (Cox & Snell R Square = .236). The magnitude of the two variables increased in the second, third, and fourth models, from 30.8% (Cox & Snell R Square = .308) to 31.3% (Cox & Snell R Square = .313) and 31.3% (Cox & Snell R Square = .313) to 33.1% (Cox & Snell R Square = .331), respectively.

6.2.3 Factors affecting female students' STEM career choices

6.2.3.1 Individual-level factors

As shown in Table 6.5, the logistic regression analysis results indicated that individual-level factors substantially impacted Cambodian female upper secondary school students' decision to pursue a STEM career. Overall, the model predicted 23.6% of the variation underlying the students' career decisions (Cox & Snell R Square = .236). This study found a substantial association of upper secondary school stream (Exp(B) = 6.41) and interest in a STEM career (Exp(B) = 5.30) with the STEM career choices of Cambodian female upper secondary school students.

With reference to the influencing factors, female secondary school students in the science stream were 6.41 times more likely to choose a STEM career than females in the social science stream ((Exp(B) = 6.41, $p < .001$). The expected value of female secondary school students in the science stream pursuing STEM careers was found to be statistically significant, with variation in the range 2.11–19.45.

Interest in a STEM career ($p < .01$) is the second factor that was found to statistically significantly influence the STEM career choices of Cambodian female upper secondary school students. Female upper secondary school students who demonstrated an interest in a STEM field were more likely to actually work in that field than those who did not show an interest. More precisely, a one-unit rise in the belief that female students interested in a STEM career are more likely to choose that career would raise the likelihood of actually doing so by a factor of 5.30 (Exp(B)=5.30). This predicted value was found to be statistically significant ($p < .01$), and the 95% CI's upper and lower bounds were 1.11 and 25.38, respectively. In simple terms, female secondary school students who have shown an interest in STEM occupations were 5.30 times more likely to actually choose a STEM career than female students who did not show an interest in a STEM career.

Regarding the variables other than the two mentioned earlier, namely whether there is an existing career plan at the present, STEM ability and achievement, STEM learning self-effacement, and interest in STEM career ($p > .05$), the present study found no statistically significant influence on Cambodian female upper secondary school students' STEM career choices.

Table 6.5: Individual-level factors influencing female students' STEM career choices

Model 1: Individual-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-5.05(2.60)		.00	
Whether there is an existing career plan at present	.11(.71)	.28	1.12	4.52
Upper secondary school stream	1.86(.57)***	2.11	6.41	19.45
STEM ability and achievement	- .91(1.11)	.04	.40	3.57
STEM learning self-efficacy	.20(.87)	.22	1.23	6.71
Interest in STEM career	1.67(.80)**	1.11	5.30	25.38
Cox & Snell R Square	.236			
Nagelkerke R Square	.317			

Note: * when $p < .05$; ** when $p < .01$; *** when $p < .001$

6.2.3.2 Family-level factors

As shown in Table 6.6, no variables classified as family-level factors had a significant influence on Cambodian female upper secondary school students' STEM career choices because their *p*-values were higher than .05 ($p < .05$). However, the research will explain the variables 'type of guardian', 'male guardian education', 'female guardian occupation', and 'guardian influence on STEM' as these had Exp(B) values greater than 1.

Regarding the first variable, female students living with their guardian were 3.66 times more likely to choose a STEM career than students who did not live with their guardian. Regarding the second variable, female students with a father with a high education level were 1.02 times more likely to choose a STEM career than female students with a father with less education. Regarding the third variable, female students with a mother who is a STEM professional were eight times more likely to choose a STEM career than female students whose mother is not a STEM professional. Regarding the last variable, female students whose parents wanted them to choose a STEM career were 1.13 times more likely to do so than female students whose parents had not expressed such a desire.

Table 6.6: Family-level factors influencing female students' STEM career choice

Model 2: Family-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-2.74(3.52)		.06	
Order of childhood	- .36(.35)	.35	.70	1.40
Type of guardian	1.30(1.09)	.43	3.66	31.22
Male guardian education	.02(.24)	.64	1.02	1.63
Female guardian education	- .11(.20)	.61	.90	1.32
Male guardian occupation	- .58(.91)	.09	.56	3.35

Female guardian occupation	2.08(1.47)	.45	8	141.49
Family income	- .43(.34)	.33	.65	1.27
Gender equality in the family	- .44(.49)	.25	.65	1.69
Guardian influencing on STEM	.12(.72)	.27	1.13	4.66
Cox & Snell R Square	.308			
Nagelkerke R Square	.414			

6.2.3.3 School-level factors

Based on the logistic regression analysis results, school-level factors did not significantly influence Cambodian female upper secondary school students' STEM career choices, and no statistical result showing the significance of the variables under this factor was derived. However, the paper will explain the variables 'STEM-related activities' and 'teacher encouragement' since their Exp(B) values were greater than 1.

Female students involved in STEM-related activities were 1.58 times more likely to choose a STEM career than female students who did not participate. Moreover, female students who received encouragement from teachers were 1.06 times more likely to choose a STEM career than female students who did not receive such support.

Table 6.7: School-level factors influencing female students' STEM career choice

Model 3: School-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-3.37(3.94)		.03	
STEM-related activities	.46(.65)	.44	1.58	5.66
Access to national career day	- .41(.66)	.18	.66	2.41
Teacher encouragement	.06(.54)	.37	1.06	3.06
Impact of online learning on STEM	- .02(.57)	.32	.98	3
Cox & Snell R Square	.313			

Nagelkerke R Square	.412

6.2.3.4 Environmental and sociological factors

As shown in Table 6.8, no variables among the environmental and sociological factors had a significant influence on Cambodian female upper secondary students' STEM career choices because their *p*-values were higher than .05 ($p < .05$). However, two variables had an Exp(B) value greater than 1, namely the presence of a female role model and access to STEM career guidance. Thus, the paper will explain these two variables in the following paragraph.

First is the female role model variable. Female students with a female role model were 2.61 times more likely to choose a STEM career than female students with no female role model. Second is STEM career guidance. It was found that female students who received STEM career guidance were 1.32 times more likely to choose a STEM career than female students who did not receive career advice.

Table 6.8: Environment and sociological-level factors influencing female students' STEM career choice

Model 4: Environmental and sociological-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-3.17(4.68)		.04	
Gender stereotype	- .59(.53)	.20	.557	1.59
Female role model	.96(.87)	.47	2.61	14.49
Advice for STEM career choice	.27(.72)	.32	1.32	5.40
Cox & Snell R Square	.331			
Nagelkerke R Square	.446			

6.3 Discussion of the results for RQ2 and derived conclusions

The most influential individual-level factors affecting female students' career choices are upper secondary school stream and interest in a STEM career. As explained in the discussion of the findings regarding RQ1, science performance influences both male and female students. A one-unit increase in female students in the science stream leads to 6.41 times increase in females' STEM career selection. However, interest in a STEM career was found to significantly influence female students only, which is in line with previous studies (Fouad & Smith, 1996; Hulleneman et al., 2008; Lent et al., 1994; Nugent et al., 2015; OECD, 2005) that have shown that career interest is positively connected to an individual's decision to enrol in a course of study in a particular field. Hence, students who show interest in STEM early in life often decide to study STEM subjects, and career interest is a predictor of career choice. A one-unit increase in interest in a STEM career among female students leads to 5.30 times increase in choosing a STEM career.

In sum, the most influential factors affecting Cambodian female upper secondary school students' STEM career choices are individual factors, which mirrors the results for RQ1. This finding is logical because the research subjects are in the same education system and country context.

CHAPTER 7: ANALYSIS OF A WEIGHTED SAMPLE

This chapter reports on another analysis with a weighted sample and compares the results to those for RQ1 and RQ2. This was done because of the current study's small sample size. It is recommended that future studies use a larger sample size.

7.1 Method

7.1.1 Data analysis method

The problem of the result of the previous chapters (chapter five and six), there were only a few variables identified as significant influences on students' STEM career choice. There are two variables from individual-level factor were found significant and no other variable in family-level, school-level, and environmental and sociological-level factors found significant. 'Gender' and 'upper secondary school stream' were found significant influence on Cambodian upper secondary school students' STEM career choice. 'Upper secondary school stream' and 'interest in a STEM career' were found significant influence on Cambodian female upper secondary school students' STEM career choice.

One of the possible explanations of the reason for the scarcity of effective influence is the sample size. Small sample size underestimates the effect of each variable. Therefore, this chapter attempts to repeat the same analysis with weighted sample. The researcher created the weight variable with the value of 5 and use weighted sample case analysis result as the reference and reflect with the original result of the study and make some suggestion to conduct larger sample size for further study.

To predict the target variable classes, binary logistic regression uses one or more predictor variables that may be continuous or categorical. This method aids in identifying significant variables (X_i) that have an influence on the target variable (Y) as well as the nature of their interactions with the dependent variable (Patel, K., 2021). To achieve the objective, which was to determine the impact of the independent variables on the STEM career choices of all the sampled Cambodian senior high school students and the female students specifically, binary logistic regression was deemed an appropriate analytical technique. A block recursive model that makes precise assumptions about the causal relationship between variables at the individual, family, school, and environmental/social level was utilized. In particular, the independent variables were placed into four 'blocks', as detailed in Table 7.1.

Table 7.1: Methods of estimation for weighted sample analysis

Model	Block of independent variables included in the regression model
1	I (Individual Factor)
2	I (Individual Factor) + II (Family Factor)
3	I (Individual Factor) + II (Family Factor) + III (School Factor)
4	I (Individual Factor) + II (Family Factor) + III (School Factor) + IV (Environmental & Sociological Factor)

The total effects of individual-level predictors on students' decision to pursue a STEM career (Model 1), the net impacts of individual-level factors as mediated by family-level predictors (Model 2), the effects of school-level predictors (Model 3), and the effects of environmental and sociological predictors (Model 4) were all identified using a block recursive model.

Data reduction was performed, in addition to the primary analysis, because the data comprised a sizable number of elements where multicollinearity might be quite frightening. For this reason, main axis factoring with Varimax and Kaiser normalization in rotation was employed in exploratory factor analysis of the survey items in order to separate the components underlying the set of items. The study's section on measurement lists the variables identified through exploratory factor analysis. Additionally, correlation analysis was performed to combine the four disciplines into STEM.

The associations between all factors were also determined, as well as whether the third variable had any bearing on how students chose a career, although logistic regression was the primary analytical technique used to answer RQ1. Collinearity statistical analysis in multiple regression was also carried out to prevent multicollinearity, and it was found that no variable had a tolerance 108 statistic lower than .05 or a VIF higher than 7 (Field, 2009). Hence, multicollinearity was not a problem.

The study employed logistic regression for the final step of data analysis to achieve the stated objective, which was designed to identify the primary variables impacting Cambodian female upper secondary school students' decision to pursue a STEM career. The variables used in the binary logistic regression analysis are listed in Table 7.2 by each block of components at the individual, family, school, and environmental and social levels. In essence, the analytical approach considered the current study's framework as well as the differences between the models. An advanced version of SPSS was used for the whole data analysis procedure.

Table 7.2: Variables included in the logistic regression model (weighted sample)

Variables	**Definition/code**
Dependent	
Career Choice	0=non-STEM, 1=STEM
Independent	
Individual factors	
Whether there is an existing career plan at present	0=no, 1=yes

Upper secondary School Stream	0=social, 1=science
STEM ability and achievement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
STEM learning self-efficacy	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Interest in STEM career	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Family factors	
Order of childhood	0=single child, 1=youngest, 2=middle, 3=oldest
Dummy type of guardian	0=alone or with non-parents,1=with guardian
Male guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Female guardian education	0=no male guardian, 1=no education, 2=primary school ,3=lower secondary, 4=upper secondary, 5=bachelor, 6=master, 7=other
Male guardian occupation	0= non-STEM, 1= STEM
Female guardian occupation	0= non-STEM, 1= STEM
Family income	1=Lower than 200, 2=200 to 400, 3=400 to 600, 4=Over 600
Gender equality in the family	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Guardian influence on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
School factors	
STEM-related activities	1=never, 2=sometime, 3=often,4=very often, 5=always
Access to national career day	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

Teacher encouragement	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Impact of online learning on STEM	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Environmental and sociological factors	
Gender stereotype	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Female role model	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree
Advice for STEM career choice	1=strongly disagree, 2=disagree, 3=normal, 4=agree, 5=strongly agree

7.2 Results

7.2.1 Descriptive results

Table 7.3 displays the descriptive statistics for the four dimensions of variables used in the binary logistic regression, including mean [M], standard deviation [SD], and minimum and maximum. The descriptive statistics also revealed some fundamental conclusions regarding particular pupils and the traits of variables in other dimensions. First is the study's dependent variable, STEM career choice.

Table 7.3: Descriptive results of the variables included in the logistic regression model (weighted sample)

Variables	Mean	SD	Minimum	Maximum
Dependent				
Career Choice	.49	.50	0	1
Independent				
Individual factors				

Gender (male=1)	.28	.45	0	1
Whether there is an existing career plan at present	.80	.40	0	1
Upper Secondary School Stream	.57	.50	0	1
STEM ability and achievement	3.37	.42	2.06	4.47
STEM learning self-efficacy	3.16	.43	2.05	4.37
Interest in STEM career	3.49	.52	1.71	4.94
Family factors				
Order of childhood	1.90	.87	0	3
Type of guardian	.84	.37	0	1
Male guardian education	2.72	1.64	0	6
Female guardian education	2.97	1.51	0	7
Male guardian occupation	.14	.35	0	1
Female guardian occupation	.04	.19	0	1
Family income	1.77	.99	1	4
Gender equality in the family	3.57	.66	1	5
Guardian influence on STEM	3.22	.47	2	5
School factors				
STEM-related activities	1.64	.61	1	4.25
Access to national career day	3.12	.75	1	5
Teacher encouragement	4.03	.65	1	5
Impact of online learning on STEM	2.65	.57	1	4.67
Environmental and sociological factors				
Gender stereotype	2.12	.73	1	5
Female role model	3.34	.65	1	5
Advice for STEM career choice	3.29	.57	1	5

7.2.2 Interpretation and overall model fit for all samples

Analysis by model (the individual-level factors model, the family-level factors model, the school-level factors model, and the environmental and sociological factors model) was conducted to better understand the factors affecting students' career choice. Given that the dependent variable was coded dichotomously, binary logistic regression using the enter method was used (0 = non-STEM career choice, 1 = STEM career choice). Three data reading techniques were implemented in this investigation to speed up interpretation of the logistic regression results. Firstly, the -2log-likelihood statistic and its associated chi-square statistic were examined to determine whether the model was a significant fit for the data. This can be ascertained using Nagelkerke R-square or the Cox & Snell R Square analogue. In statistical terms, the proportion demonstrated the difference in the students' career choice, which was explained by a combination of factors under each main factor (i.e., individual, family, school, and environmental and sociological factors). The Cox & Snell R Square was employed in the interpretation of this study's results since it was more reliable than its alternative. The Cox & Snell R Square was in the range 0–0.75, and the Nagelkerke R Square was in the range 0–1. Secondly, the researcher looked at the value of the coefficient (*B*) to determine the relationships between each variable that contributed to explaining the differences in the students' career choice. Interpretation was based on the numerical value and the sign orientation. For instance, a negative coefficient in an equation where career choice was the referenced category denoted that individuals were more likely to choose a non-STEM career than a STEM career if the independent variables were greater, and vice versa. Thirdly, when exponentiated and deducted from 1, the coefficient or odds ratio *Exp(B)* was understood as a measurement of the change in odds brought about by a unit change in the predictor variables. In simple terms, it indicated how much each key predictor variable changed in relation to the probability of students choosing a STEM career. The coefficient was transformed into percentage difference in likelihood using the method *[Exp(coefficient)-1] x 100* for ease of understanding.

Let us look at the general fit of the data to the model before delving more deeply into explaining each major variable. According to the logistics regression analysis results (Cox & Snell R Square = .267; see Table 7.4), the overall factors influencing the career choices of Cambodian upper secondary students accounted for 26.7% of the variation in those decisions. Specifically, 16.4% (Cox & Snell R Square = .164) of the variation describing Cambodian upper secondary students' career choices was explained by determinants at the individual-level. The variation impacting students' career choice increased to 23.4% (Cox & Snell R Square = .234) and 25.6% (Cox & Snell R Square = .256) for the individual component in the second and third regression models, respectively. The model's -2log-likelihood ratio was significant, as evidenced by the fact that the chi-square value was less than .05 (p = .000). Most importantly, the Hosmer and Lemeshow test chi-square value was higher than .05 ($p > .05$), indicating that the model was correctly specified. Based on the statistical findings, it was possible to conclude that the model significantly and successfully fit the data. The model testing results suggest, theoretically speaking, that the data are consistent with the application of the conceptual models that served as the conceptual foundation for the current investigation.

Table 7.4: Estimation results of upper secondary school students' STEM career choice (weighted sample)

Significant Predictors	*Model 1*		*Model 2*		*Model 3*		*Model 4*	
	B(SE)	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***
Gender	.95(.21)***	2.58	.90(.22)***	2.46	.69(.23)**	1.99	.61(.24)*	1.83
Upper Secondary School Stream	1.30(.19)***	3.68	1.62(.23)***	5.07	1.57(.24)***	4.79	1.67(.25)***	5.29
Interest in STEM career	.52(.25)*	1.68	.82(.28)**	2.29	.98(.29)***	2.66	1.10(.30)***	2.99
Order of childhood			-.25(.12)*	.78	-.27(.13)*	.76	-.27(.13)*	.76
Type of guardian			1.17(.36)***	3.24	1.41(.39)***	4.11	1.42(.40)***	4.14
Male guardian occupation			-.82(.32)*	.44	-.92(.65)**	.40	-1.08(.36)**	.34
Female guardian occupation			1.64(.60)**	5.17	.95(.65)	2.60	.90(.70)	2.47
Family income			-.21(.12)	.81	-.34(.13)**	.71	-.37(.13)**	.69
Gender equality in the family			-.54(.17)***	.58	-.46(.18)*	.63	-.41(.18)*	.66
Guardian influence on STEM			.53(.24)*	1.70	.44(.24)	1.56	.62(.26)*	1.85
Access to national career day					-.79(.22)***	.45	-.74(.23)***	.48
Teacher encouragement					.49(.19)**	1.64	.40(.20)*	1.50
Gender stereotype							-.38(.17)*	.68
Cox & Snell R Square	.164		.234		.256		.267	
Nagelkerke R Square	.220		.313		.342		.357	

Note: * when p < .05; ** when p < .01; *** when p < .001

Secondly, Table 7.4 highlights the significant impact of sociological elements at the individual, family, school, and environmental levels on the career choice of Cambodian upper secondary school students. As the content of the table implies, the first model (for individual-level factors) showed estimates of the important variables' 'gender', 'upper secondary school stream', and 'interest in a STEM career' when the other major factors were not considered. Thus, 16.4% of these variables' total variation in students' career choices was explained (Cox & Snell R Square = .164).

Remarkably, the integration of the second model (for family-level factors) into the first model—order of childhood, type of guardian, male guardian occupation, female guardian occupation, gender equality in the family, and guardian influence on STEM—expanded the total variance in students' career choices. Of the total variance explained by the first model (16.4%), family-level factors increased the variance to 23.4% (an increase of about 7%). However, inclusion of this model increased the effect of interest in a STEM career in the first model, as evidenced by the fact that the coefficient of interest in a STEM career decreased from .039 to .003 ($p < .05$).

The integration of the third model (school-level factors) into the second model—access to national career day and teacher encouragement—expanded the total variance. Of the total variance, that explained by the third model was 25.6% (an increase of about 2.2%). However, inclusion of this model increased the effect of interest in a STEM career in the second model, as evidenced by the fact that its coefficient decreased from .003 to .001 ($p < .001$). Regarding another individual-level variable, this model neutralized the effect of gender, as evidenced by the fact that the coefficient of gender increased from .000 to .003. However, this model increased the effect of male guardian occupation and family income in the second model, as evidenced by the fact that the coefficient of male guardian occupation decreased from .012 to .006 ($p < .01$)

and that of family income decreased from .081 to .006 ($p < .01$). This model neutralized the effect of female guardian occupation and gender equality in the family in the second model, as evidenced by the fact that the coefficient of female guardian occupation was low, at .141 ($p < .05$), and that of gender equality in the family increased from .001 to .011 ($p < .05$) but was also still quite low.

Lastly, the integration of the fourth model (school-level factors) into the third model—gender stereotype—expanded the total variance. The total variance explained by the entire model was 26.7%, and the third model added 1.1% to the variance in students' career choices. However, inclusion of this model neutralized the effect of gender, as evidenced by the fact that the coefficient of gender increased from .003 to .013 ($p < .05$). Apart from gender, which was an individual-level variable, this model neutralized the effect of female guardian occupation, as evidenced by the fact that the coefficient of female guardian occupation increased from .141 to .199 ($p < .05$). Regarding school-level variables, this model neutralized the effect of teacher encouragement, as evidenced by the fact that the coefficient of teacher encouragement increased from .009 to .044 ($p < .05$).

7.2.3 Factors affecting students' career choices (weighted sample)

7.2.3.1 Individual-level factors

The logistic regression analysis results indicated that individual-level factors strongly affected the STEM career choices of Cambodian upper secondary school students. Overall, the model explained 16.4% of the variation in students' career choices (Cox & Snell R Square = .164; see Table 7.5). The decision to enrol in a course of study in a particular discipline, attention to learning, individual character, personal capacities, interest, habits, and principles are some of the important variables that survived in the model. Cambodian upper secondary school students' gender (Exp(B) = 2.58), upper secondary school stream (Exp(B) = 3.68) and interest in a STEM career (Exp(B) = 1.68) strongly influenced their STEM career choice.

With reference to the influencing factors, male secondary school students were 2.58 times more likely to choose a STEM career than female secondary school students ((Exp(B) = 2.58, $p < .001$). The expected value of male secondary school students who chose a STEM career was found to be statistically significant, with variation in the range of 1.07 to 3.91.

The second variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is upper secondary school stream ($p < .001$). Students in the science stream/track were more likely to choose a STEM career than those in the social science stream/track. More specifically, a one-unit increase in positive STEM perception among students in the science stream increased the odds of choosing a STEM career by a factor of 3.68 (Exp(B)= 3.68). This expected value was revealed to be statistically significant ($p < .001$), with variation ranging from 2.51 at the lower bound to 5.40 at the upper bound of the 95% CI. In simple terms, secondary school students in the science stream had a 3.68 times greater probability of choosing a STEM career than students in the social science stream.

The last variable classified as an individual-level factor that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choices is interest in a STEM career ($p < .05$). Students who showed interest in a STEM career were more likely to choose a STEM career than those who did not show an interest. More specifically, a one-unit increase in positive STEM perception among students interested in a STEM career would increase the odds of choosing a STEM career by a factor of 1.68 (Exp(B) = 1.68). This expected value was revealed to be statistically significant ($p <.05$), with variation ranging from

1.03 at the lower bound to 2.75 at the upper bound of the 95% CI. In simple terms, students who show an interest in a STEM career at the secondary school level have a 1.68 times greater probability of choosing a STEM career than students who do not show an interest.

Regarding the variables other than the three mentioned earlier, namely whether the respondent had a career plan at the time of the survey, STEM ability and achievement, and STEM learning self-effacement ($p > .05$), this study found that these did not exert a statistically significant influence on Cambodian upper secondary school students' STEM career choices.

Table 7.5: Individual-level factors influencing students' STEM Career choice (weighted sample)

Model 1: Individual-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.40(.83)***		.01	
Gender (Male=1)	.95(.21)***	1.07	2.58	3.91
Upper secondary school stream	1.30(.19)***	2.51	3.68	5.40
Interest in STEM career	.52(.25)*	1.03	1.68	2.75
Cox & Snell R Square	.164			
Nagelkerke R Square	.220			

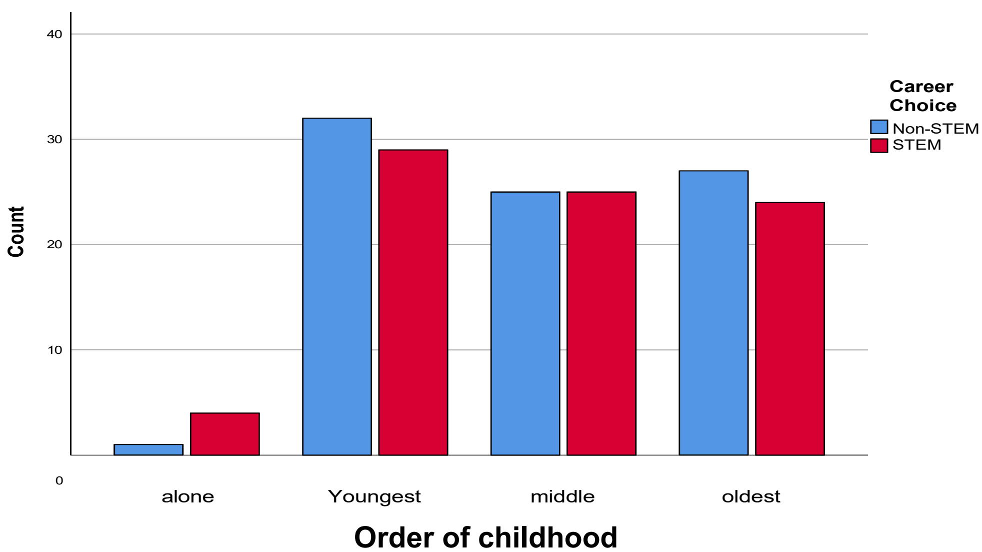
Note: * when $p < .05$; ** when $p < .01$; *** when $p < .001$

7.2.3.2 Family-level factors

The logistic regression analysis results indicated that family-level factors strongly affected the STEM career choices of Cambodian upper secondary school students. Overall, the model explained 23.4% of the variation in the students' career choices (Cox & Snell R Square = .234). As can be seen in Table 7.6, six variables classified as familial factors had a significant influence on Cambodian upper secondary school students' STEM career choices. These variables' *p*-values were lower than .05 ($p < .05$): sibling order ($p < .05$), type of guardian (p

< .001), paternal occupation ($p < .05$), female guardian occupation ($p < .01$), gender equality in the family ($p < .001$) and guardian influence on STEM ($p < .05$).With reference to the influencing factors, among the secondary school students, those who are an only child had a greater probability of choosing a STEM career at a rate.78 times higher than secondary school students with siblings ((Exp(B) = .78, $p < .05$). The expected value of secondary school students who are only children regarding choosing a STEM career was found to be statistically significant, with variation in the range of .61 to .99.

Figure 2.1: STEM and non-STEM career choice by order of childhood



The second variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choices is type of guardian ($p < .001$). Students living with their parent(s) were more likely to choose a STEM career than those with other living arrangements. More specifically, a one-unit increase in positive STEM perception among students living with their parent(s) would increase the odds of choosing a STEM career by a factor of 3.24 (Exp(B)= 3.24). This expected value was revealed to be statistically significant (p <.001), with variation ranging from 1.58 at the lower bound to 6.62 at the upper bound of the

95% CI. In simple terms, secondary school students living with their parent(s) had a 3.24 times greater probability of choosing a STEM career than those with other living arrangements.

The third variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is paternal occupation ($p < .05$). It was found that students with a father who is a STEM professional were more likely to choose a STEM career than those with a father who is not a STEM professional. More specifically, a one-unit increase in positive STEM perception among students whose father is a STEM professional would increase their odds of choosing a STEM career by a factor of 4.4 (Exp(B) = .44). This expected value was revealed to be statistically significant ($p <.05$), with variation ranging from .23 at the lower bound to .83 at the upper bound of the 95% CI. In simple terms, secondary school students with a father who is a STEM professional had a .44 times greater probability of choosing a STEM career than those whose father is not a STEM professional.

The fourth variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is maternal occupation ($p < .01$). Students with a mother who is a STEM professional are more likely to choose a STEM career than those whose mother is not a STEM professional. More specifically, a one-unit increase in positive STEM perception among students whose mother is a STEM professional would increase the odds of choosing a STEM career by a factor of 5.17 (Exp(B) = 5.17). This expected value was revealed to be statistically significant ($p < .05$), with variation ranging from 1.57 at the lower bound to 17.01 at the upper bound of the 95% CI. In simple terms, secondary school students whose mother is a STEM professional had a 5.15 times greater probability of choosing a STEM career than students whose mother was not a STEM professional.

The fifth variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is gender equality in the family ($p < .001$). It was found that students who are treated equally in relation to their opposite gender siblings were more likely to choose a STEM career than those who are not treated equally. More specifically, a one-unit increase in positive STEM perception among students who are treated equally in relation to their opposite gender siblings would increase the odds of choosing a STEM career by a factor of .58 (Exp(B)= .58). This expected value was revealed to be statistically significant ($p <.001$), with variation ranging from .41 at the lower bound to .81 at the upper bound of the 95% CI. In simple terms, secondary school students who are treated equally in relation to their opposite gender siblings had a .58 times greater probability of choosing a STEM career than students who are not treated equally.

The last variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is parental influence on STEM ($p < .05$). It was found that students with a positive parental STEM influence were more likely to choose a STEM career than those without such an influence. More specifically, a one-unit increase in positive STEM perception among students with a parental STEM influence would increase the odds of choosing a STEM career by a factor of 1.70 (Exp(B)= 1.70). This expected value was revealed to be statistically significant ($p <.05$), with variation ranging from 1.07 at the lower bound to 2.69 at the upper bound of the 95% CI. In simple terms, secondary school students with a positive parental STEM influence had a 1.70 times greater probability of choosing a STEM career than those without such an influence.

Regarding the variables other than the six mentioned earlier, namely paternal education, maternal education, and family income ($p > .05$), this study found that these did not statistically significantly influence Cambodian upper secondary school students' STEM career choices.

Table 7.6: Family-level factors influencing students' STEM Career choice (weighted sample)

Model 2: Family-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.47)1.15)***		.01	
Order of childhood	- .25(.12)*	.61	.78	.99
Type of guardian	1.17(.36)***	1.58	3.24	6.62
Male guardian occupation	- .82(.32)*	.23	.44	.83
Female guardian occupation	1.64(.60)**	1.57	5.17	17.01
Gender equality in the family	- .54(.17)***	.41	.58	.81
Guardian influencing on STEM	.53(.24)*	1.07	1.70	2.69
Cox & Snell R Square	.234			
Nagelkerke R Square	.313			

Note: * when p < .05; ** when p < .01; *** when p < .001

7.2.3.3 School-level factors

The logistic regression analysis results indicated that school-level factors strongly affected the STEM career choices of Cambodian upper secondary school students. Overall, the model explained 25.6% of the variation in students' career choice (Cox & Snell R Square = .256). As shown in Table 7.7, two variables classified as school-level factors had a significant influence on Cambodian upper secondary students' STEM career choice. These variables' *p*-values were lower than .05 ($p<.05$): access to national career day ($p < .001$) and teacher encouragement ($p < .01$).

The first variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is access to national career day ($p < .001$). It was found that students who participated in national career day were more likely to choose a STEM career than those who did not participate. More specifically, a one-unit increase in positive STEM perception among students participating in national career day would increase the odds of choosing a STEM career by a factor of .45 (Exp(B) = .45). This expected value was revealed to be statistically significant ($p < .001$), with variation ranging from .29 at the lower bound to .71 at the upper bound of the 95% CI. In simple terms, secondary school students who attended national career day had a .45 times greater probability of choosing a STEM career than those who did not attend.

The last variable among the school-level factors that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choices is teacher encouragement ($p < .01$). It was found that students who received encouragement from their teachers were more likely to choose a STEM career than those who did not receive such support. More specifically, a one-unit increase in students who, in their perception, received encouragement from their teachers increased the odds of choosing a STEM career by a factor of 1.64 (Exp(B) = 1.64). This expected value was revealed to be statistically significant ($p < .01$), with variation ranging from 1.13 at the lower bound to 2.37 at the upper bound of the 95% CI. In simple terms, secondary school students who received encouragement from their teachers had a 1.64 times greater probability of choosing a STEM career than students who did not receive such support.

Table 7.7: School-level factors influencing students' STEM Career choice (weighted sample)

Model 3: School-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-5.98(1.29)***		.00	
Access to national career day	- .79(.22)***	.29	.45	.71
Teacher encouragement	.49(.20)**	1.13	1.64	2.37
Cox & Snell R Square	.256			
Nagelkerke R Square	.342			

Note: * when p < .05; ** when p < .01; *** when p < .001

7.2.3.4 Environmental and sociological factors

The logistic regression analysis results indicated that environmental and sociological factors strongly affected the STEM career choices of Cambodian upper secondary school students. Overall, the model explained 26.7% of the variation in students' career choice (Cox & Snell R Square = .267). As shown in Table 7.8, only one variable classified as an environmental and sociological factor had a significant influence on Cambodian upper secondary school students' STEM career choice. This variable had a *p*-value lower than .05: gender stereotypes ($p < .05$).

With reference to the influencing factors, it was found that secondary school students who never experienced gender stereotypes had a greater probability of choosing a STEM career at a rate .68 times higher than secondary school students who experienced gender stereotypes ((Exp(B) = .68, p <.05). The expected value of secondary school students who never experienced gender stereotypes regarding selecting a STEM career was found to be statistically significant, with variation in the range .61–.99.

Table 7.8: Environment and sociological-level factors influencing students' STEM Career choice (weighted sample)

Model 4: Environmental and sociological-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-4.16(1.44)**		.01	
Gender stereotype	- .38(.17)*	.49	.68	.95
Cox & Snell R Square	.267			
Nagelkerke R Square	.357			

Note: * when p < .05; ** when p < .01; *** when p < .001

7.2.4 Interpretation and overall model fit for the all-female sample

Analysis by model (the individual-level factors model, the family-level factors model, the school-level factors model, and the environmental and sociological factors model) was conducted to better understand the factors affecting female students' career choice. Given that the dependent variable was coded dichotomously, binary logistic regression with the enter method was used (0 = non-STEM career choice, 1 = STEM career choice). Three data reading techniques were implemented in this investigation to speed up interpretation of the logistic regression results. Firstly, the -2log-likelihood statistic and its associated chi-square statistic were examined to determine whether the model was a significant fit for the data. This can be accomplished using Nagelkerke R-square or the Cox & Snell R Square analogue. In statistical terms, the proportion demonstrated the difference in the female students' career choices, which was explained by a combination of factors under each main factor (i.e., individual, family, school, and environmental and sociological). The Cox & Snell R Square was employed in the interpretation of this study's results since it is more reliable than its alternative. The Cox & Snell

R Square was in the range 0–0.75, whereas the Nagelkerke R-square was in the range 0–1. Secondly, the researcher looked at the value of the coefficient (*B*) to determine the relationships between each variable that contributed to explaining the differences in the female students' career choices. Interpretation was based on the numerical value and the sign orientation. For example, a negative coefficient in an equation where career choice was the referenced category denoted that individuals were more likely to choose a non-STEM career than a STEM career if the independent variables were greater, and vice versa. Third, when exponentiated and deducted from 1, the coefficient or odds ratio *Exp(B)* was understood as a measurement of the change in odds brought about by a unit change in the predictor variables. In simple terms, it indicated how much each key predictor variable changed in relation to the probability that female students would select a STEM career. The coefficient was transformed into percentage difference in likelihood using the method *[Exp(coefficient)-1] x 100* for ease of understanding.

Let us look at the general fit of the data to the model before delving more deeply into explaining each major variable. According to the logistics regression analysis results (Cox & Snell R-quare = .331; see Table 7.9), the overall factors influencing the career choices of Cambodian female upper secondary school students accounted for 33.1% of the variation in those decisions. Specifically, 23.6% (Cox & Snell R Square = .236) of the variation describing the career choice of Cambodian female upper secondary school students was explained by determinants at the individual-level. The variation impacting female students' career choice increased to 30.8% (Cox & Snell R Square = .308) and 31.3% (Cox & Snell R Square = .313) for the individual component in the second and third regression models, respectively. The model's -2log-likelihood ratio was significant, as evidenced by the fact that the chi-square values were less than .05 ($p = .000$). Most importantly, the Hosmer and Lemeshow test chi-square value was higher than .05 (p >.05), indicating that the model was correctly specified. Based on the statistical findings, it was possible to conclude that the model significantly and successfully fit the data. The model testing results suggest, theoretically speaking, that the data are consistent with the application of the conceptual models that served as the conceptual foundation for the current investigation.

Table 7.9: Estimate results of upper secondary school female students' STEM career choice (weighted sample)

Significant Predictors	***Model 1***		***Model 2***		***Model 3***		***Model 4***	
	B(SE)	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***	**B(SE)**	***Ex(B)***
Upper Secondary School Stream	1.86(.25)***	6.41	2.64(.35)***	14.06	2.63(.37)***	13.88	3(.41)***	20.15
STEM ability & achievement	-.91(.50)	.40	-1.45(.62)*	.23	-.135(.66)*	.26	-1.38(.74)	.25
Interest in STEM career	1.67(.36)***	5.30	2.02(.42)***	7.54	2.18).44)***	8.87	2.20).49)***	8.99
Order of childhood			-.36(.16)*	.70	-.31(.16)*	.73	- .23(.17)	.80
Type of guardian			1.30(.49)**	3.66	1.31(.51)*	3.71	1.47(.53)**	4.35
Female guardian occupation			2.08(.65)**	8	1.80(.75)*	6.06	1.03(.83)	2.80
Family income			-.43(.15)**	.65	-.45(.15)**	.64	-.55(.17)***	.41
Gender equality in the family			-.44(.22)*	.65	-.39(.23)	.68	-.28(.23)	.76
Access to national career day					-.41(.30)	.66	-.74(.33)*	.48
Gender stereotype							-.59(.24)*	.56
Female role model							.96(.39)*	2.61
Cox & Snell R Square	.236		.308		.313		.331	
Nagelkerke R Square	.317		.414		.421		.446	

Note: * when p < .05; ** when p < .01; *** when p < .001

Secondly, Table 7.9 highlights the significant impact of sociological elements at the individual, family, school, and environmental levels on the career choices of Cambodian female upper secondary school students. As the content of the table implies, the first model (for individual-level factors) showed estimates of the important variables ‘upper secondary school stream’ and ‘interest in a STEM career’ when the other major factors were not considered. Thus, 23.6% of these variables' total variation in female students' career choices was explained (Cox & Snell R Square = .236).

Remarkably, the integration of the second model (for family-level factors) into the first model—order of childhood, type of guardian, family income, female guardian occupation, and gender equality in the family—expanded the total variance in female students' career choices. Of the total variance explained by the first model (23.6%), family-level factors increased the variance in female students’ career choices to 30.8% (an increase of about 7.2%). However, inclusion of this model increased the effect of STEM ability and achievement in the first model, as evidenced by the fact that the coefficient of interest in a STEM career decreased from .068 to .019 ($p < .05$).

The integration of the third model (school-level factors) into the second model—access to national career day—expanded the total variance in female students' career choices. Of the total variance, the third model explained 31.3% (an increase of about 0.5%). However, inclusion of this model neutralized the effects of type of guardian, female guardian occupation, and gender equality in the family in the second model, as evidenced by the fact that the coefficients of those variables increased from .008 to .011, .002 to .016, and .046 to .086, respectively.

Lastly, integration of the fourth model (school-level factors) into the third model—gender stereotypes and presence of a female role model—expanded the total variance. Of the total variance explained by the entire model (33.1%), the third model added 1.8% to the variance in female students' careers choice. However, inclusion of this model neutralized the effect of STEM ability and achievement, as evidenced by the fact that the coefficient of gender increased from .039 to .060 (p < .05). Regarding the variables classified as family-level, this model increased the effects of type of guardian and family income, as evidenced by the fact that their coefficients decreased from .011 to .006 and .003 to .001, respectively. This model neutralized the effects of female guardian occupation and gender equality in the family, as evidenced by the fact that their coefficients increased from .016 to .213 and .086 to .757, respectively. Regarding the school-level variables, this model increased the effect of access to national career day, as evidenced by the fact that its coefficient decreased from .16 to .024.

7.2.5 Factors affecting female students' career choices (weighted sample)

7.2.5.1 Individual-level factors

The logistic regression analysis results indicated that individual-level factors strongly affected the STEM career choices of Cambodian female upper secondary school students. Overall, the model explained 23.6% of the variation in female students' career choices (Cox & Snell R Square = .236; see Table 7.10). The decision to enrol in a course of study in a particular discipline, attention to learning, individual character, personal capacities, interest, habits, and principles are some of the important variables that survived in the model. Cambodian female upper secondary school students' STEM career choices were strongly influenced by upper secondary school stream (Exp(B) = 6.41) and interest in a STEM career (Exp(B) = 5.30).

The first variable that showed a statistically significant influence on Cambodian upper secondary school students' STEM career choice is upper secondary school stream (p < .001). It was found that female students in the science stream/track were more likely to choose a STEM career than those in the social science stream/track. More specifically, a one-unit increase in positive STEM perception among female students in the science stream would increase the odds of choosing a STEM career by a factor of 6.41 (Exp(B) = 6.41). This expected value was revealed to be statistically significant ($p < .001$), with variation ranging from 3.90 at the lower bound to 10.53 at the upper bound of the 95% CI. In simple terms, female secondary school students in the science stream had a 6.41 times greater probability of choosing a STEM career than female students in the social science stream.

The last variable classified as an individual-level factor that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is interest in a STEM career ($p < .001$). It was found that female students who showed an interest in a STEM career were more likely to choose a STEM career than those who did not show an interest. More specifically, a one-unit increase in positive STEM perception among students interested in a STEM career would increase the odds of actually choosing a STEM career by a factor of 5.30 (Exp(B) = 5.30). This expected value was revealed to be statistically significant ($p < .001$), with variation ranging from 2.63 at the lower bound to 10.67 at the upper bound of the 95% CI. In simple terms, female secondary school students who showed an interest in a STEM career had a 1.68 times greater probability of choosing a STEM career than female students who did not show an interest.

Regarding the variables other than the two mentioned earlier, namely whether the respondent had a career plan at the time of the survey, STEM ability and achievement, and STEM learning self-effacement ($p > .05$), this study found that these variables did not statistically significantly influence Cambodian female upper secondary school students' STEM career choice.

Table 7.10: Individual-level factors influencing female students' STEM Career choice (weighted sample)

Model 1: Individual-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-5.06(1.16)***		.01	
upper secondary school stream	1.86(.25)***	3.90	6.41	10.53
Interest in STEM career	1.67(.36)***	2.63	5.30	10.67
Cox & Snell R Square	.236			
Nagelkerke R Square	.317			

Note: * when $p < .05$; ** when $p < .01$; *** when $p < .001$

7.2.5.2 Family-level factors

The logistic regression analysis results indicated that family-level factors strongly affected the STEM career choices of Cambodian upper secondary school students. Overall, the model explained 30.8% of the variation in students' career choice (Cox & Snell R Square = .308). As shown in Table 7.11, five variables classified as familial factors had a significant influence on Cambodian upper secondary school students' STEM career choice. These variables' *p*-values were lower than .05 ($p < .05$): such as *order of childhood* ($p < .05$), type of guardian ($p < .01$), female guardian occupation ($p < .01$), family income ($p < .01$), and gender equality in the family ($p < .05$).

With reference to the influencing factors, female secondary school students who are an only had a greater probability of choosing a STEM career at a rate .70 times higher than those with siblings ((Exp(B) = .70, $p < .05$). The expected value of female secondary school students who are an only child regarding selection of a STEM career was found to be statistically significant, with variation in the range.51–.95.

The second variable that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is type of guardian ($p < .01$). It was found that female students living with their parents were more likely to choose a STEM career than those with other living arrangements. More specifically, a one-unit increase in positive STEM perception among female students living with their parents would increase the odds of choosing a STEM career by a factor of 3.66 (Exp(B) = 3.66). This expected value was revealed to be statistically significant ($p < .001$), with variation ranging from 1.40 at the lower bound to 9.55 at the upper bound of the 95% CI. In simple terms, female secondary school students living with their parents had a 3.66 times greater probability of choosing a STEM career than female students with other living arrangements.

The third variable that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is maternal occupation ($p < .01$). It was found that female students whose mother is a STEM professional were more likely to choose a STEM career than those whose mother is not a STEM professional. More specifically, a one-unit increase in positive STEM perception among female students whose mother is a STEM professional would increase the odds of choosing a STEM career by a factor of eight (Exp(B) = 8). This expected value was revealed to be statistically significant ($p < .01$), with variation ranging from 2.21 at the lower bound to 28.92 at the upper bound of the 95% CI. In simple terms, female secondary school students whose mother is a STEM professional had an eight times greater probability of choosing a STEM career than female students whose mother is not a STEM professional.

The fourth variable that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is family income ($p < .01$). A one-unit increase in family income would increase the odds of a female student choosing a STEM career by .65 times compared to female students whose family income is one unit lower. This expected value was found to be statistically significant ($p < .01$), with variation ranging from .48 at the lower bound to .68 at the upper bound of the 95% CI.

The last variable that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is gender equality in the family ($p < .05$). It was found that female students who are treated equally in relation to their male siblings were more likely to choose a STEM career than those who are not treated equally. More specifically, a one-unit increase in positive STEM perception among female students who are treated equally in relation to their male siblings would increase the odds of the females choosing a STEM career by a factor of .65 (Exp(B) = .65). This expected value was revealed to be statistically significant ($p < .05$), with variation ranging from .42 at the lower bound to .99 at the upper bound of the 95% CI. In simple terms, female secondary school students who are treated equally in relation to their male siblings had a .65 times greater probability of choosing a STEM career in the future than female students who are not treated equally as their male siblings.

Regarding the variables other than the five mentioned earlier, namely male guardian education, female guardian education, male guardian occupation, and guardian influence on STEM ($p > .05$), this study found that these variables did not statistically significantly influence Cambodian female upper secondary school students' STEM career choices.

Table 7.11: Family-level factors influencing female students' STEM Career choice (weighted sample)

Model 2: Family-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-2.74(1.57)		.06	
Order of childhood	-.36(.16)*	.51	.70	.95
Type of guardian	1.30(.49)**	1.40	3.66	9.55
Female guardian occupation	2.08(.65)**	2.21	8	28.92
Family income	-.43(.15)**	.48	.65	.88
Gender equality in the family	-.44(.22)*	.42	.65	.99
Cox & Snell R Square	.308			
Nagelkerke R Square	.414			

Note: * when $p < .05$; ** when $p < .01$; *** when $p < .001$

7.2.5.3 School-level factors

Overall, the model explained 31.3% of the variation in female students' career choice (Cox & Snell R Square = .313). No variables classified as school-level factor had a significant influence on Cambodian female upper secondary students' STEM career choice, as evidenced by the fact that the *p*-value was higher than .05 ($p > .05$) .

7.2.5.4 Environmental and sociological factors

The logistic regression analysis results indicated that environmental and sociological factors strongly affected the STEM career choices of Cambodian female upper secondary school students. Overall, the model explained 33.1% of the variation in students' career choice (Cox & Snell R Square = .331). Like the result shown in Table 7.12 two variables classified as environmental and sociological factors had a significant influence on Cambodian female upper secondary students' STEM career choice. These variables' *p*-values were lower than .05 ($p < .05$): gender stereotypes and presence of a female role model.

With reference to the influencing factors, female secondary school students who never experienced gender stereotypes had a greater probability of choosing a STEM career at a rate.56 times higher than those who experienced gender stereotypes ((Exp(B)=.56, $p < .05$). The expected value of female secondary school students who never experienced gender stereotypes regarding selection of a STEM career was found to be statistically significant, with variation in the range .35–.89.

The last variable that showed a statistically significant influence on Cambodian female upper secondary school students' STEM career choice is having a female role model ($p < .05$). It was found that female students with a female role model were more likely to choose a STEM career than those without one. More specifically, a one-unit increase in female students' access to a female role model linked to STEM would increase the odds of choosing a STEM career by a factor of 2.61 (Exp(B) = 2.61). This expected value was revealed to be statistically significant ($p < .05$), with variation ranging from 1.22 at the lower bound to 5.62 at the upper bound of the 95% CI. In simple terms, female secondary school students with a female role model had a 2.61 times greater probability of choosing a STEM career than female students without one.

Table 7.12: Environmental and sociological-level factors influencing female students' STEM Career choice (weighted sample)

Model 4: Environmental and sociological-level factors	B(SE)	95% C.I. for EXP(B)		
		Lower	Exp(B)	Upper
Constant	-3.17(2.30)		.04	
Gender stereotype	-.59(.24)*	.35	.56	.89
Female role model	.96(.39)*	1.22	2.61	5.62
Cox & Snell R Square	.331			

Nagelkerke R Square	.446

Note: * when p < .05; ** when p < .01; *** when p < .001

7.3 Discussion of the analytical results for the weighted sample and derived conclusions

Referencing the study's original sample size, two variables classified as individual-level factors, namely gender and upper secondary school stream, had a significant influence on upper secondary school students' STEM career choice. The variables classified under other factors (i.e., family-level, school-level, and environmental and sociological-level) showed no significant influence on upper secondary school students' STEM career choice. Two variables classified as individual-level factors, namely upper secondary school stream and interest in a STEM career, had a significant influence on female upper secondary school students' STEM career choice. The variables classified as other factors (i.e., family-level, school-level, and environment and sociological-level) showed no significant influence on female upper secondary school students' STEM career choice.

Regarding the results of analysis of the weighted sample, three variables classified as individual-level factors, namely gender, upper secondary school stream, and interest in a STEM career, had a significant influence on upper secondary school students' STEM career choice. Six variables classified as family-level factors had a significant influence on all Cambodian upper secondary school students' STEM career choices, namely order of childhood, type of guardian, male guardian occupation, female guardian occupation, gender equality in the family, and parental influence on STEM. Two variables classified as school-level factors had a significant influence on all Cambodian upper secondary school students' STEM career choices, namely access to national career day and teacher encouragement. Only one variable classified as an environmental and sociological factor had a significant influence on all Cambodian upper secondary school students' STEM career choice: gender stereotypes. In the all-female sample, upper secondary school stream and interest in a STEM career strongly influenced female students' STEM career choice. Five variables classified as family factor factors had a significant influence on Cambodian female upper secondary school students' STEM career choices: order of childhood, type of guardian, female guardian occupation, family income, and gender equality in the family. Regarding variables classified as school-level factors, no significant influence on Cambodian female upper secondary students' STEM career choices was found. Two variables classified as environmental and sociological factors had a significant influence on Cambodian female upper secondary school students' STEM career choices: gender stereotypes and having a female role model.

Based on the results of the weighted sample analysis, more variables classified as individual-level, family-level, school-level, and environmental and sociological factors had a significant influence on upper secondary school students' STEM career choices. Therefore, increasing the sample size in future research would produce results that differ from those of the present study.

CHAPTER 8: CONCLUSION AND IMPLICATIONS

8.1 Conclusion

The main purpose of the current study was to understand the factors influencing both male and female Cambodian upper secondary school students' STEM career choices. The study also sought to identify those factors influencing female students' STEM career choices specifically. With acute awareness of the issues surrounding the abovementioned main purpose, the current study attempted to answer two research questions and drew the following conclusions in respect to each.

- Regarding *Research Question 1* on Cambodian upper secondary school students' STEM career choices, the study found that the individual factors 'gender' and 'upper secondary school stream' affected students' STEM career choices.
- Regarding *Research Question 2* on Cambodian female upper secondary school students' STEM career choices, the study found that the individual factors 'upper secondary school stream' and 'interest in a STEM career' affected female students' STEM career choices.

Based on literature review, there are four level of factors affecting students' choice of STEM career, Career interest and self-efficacy from individual factors were found significant influence on student career choice. For family factors: parent impact, parents' gender labeling and promoted gender-typed profession decision-making were found significant. For school factor: role of teachers and educators were found significant, For the last, environment and sociology factor, social beliefs was found significant.

Lack of mentoring and caring policies, fail employment labors, social factor, organized structures, bad quality of guidance, primary schooling classroom atmosphere, gender biases, lack of female role models, STEM instruction, deficient common goal line or cooperative effort chances. The factors mentioned above cause many females to distinguish that STEM is ‘not for them’ and select other majors and profession tracks (Zachmann, 2018).

The findings of the study have shown that the most influential factors for predicting both male and female Cambodian upper secondary school students’ STEM career choices are individual factors. We should pay more attention to other factors that exert an indirect effect in order to help students be aware of their major decision making, including career choice, by giving them proper guidelines and a beneficial orientation. This is imperative because an incorrect decision could ruin their future professional life.

8.2 Implications

From a gender perspective, male students tend to have more positive attitudes towards science than female students (Crisp & Nora, 2006; Francis & Greer, 1999; Hodson & Freeman, 1983; OECD, 2016; Simpson & Oliver,1990). Male students have an advantage over female students in terms of their science and mathematics self-concept and their involvement in science-related extracurricular activities as well as science activities outside of school. It is possible that some of these inconsistencies can be attributed to Cambodians' cultural conception of science as a male-dominated discipline, particularly if students sense this attitude from their parents. This assumption is further supported by empirical observations that females have less favourable attitudes towards science because of their science-related self-conceptions, including their views on the female minority in science classes (Handley & Morse, 1984; OECD, 2016). In the Cambodian context, science is associated with male-dominated jobs (Kaing, 2016). Thus, female students tend to swing from science courses in their schooling, particularly in higher grades (Kao, 2021). Additionally, since Cambodian female upper secondary school students (aged 18–22 years) typically spend their free time helping with household chores like cooking and cleaning, they may not have enough time to study science subjects at home. Students need more time to study science subjects compared to other subjects because the former are typically perceived as being difficult (CDRI, 2015). According to the norms of Cambodian society, female students are expected to stay at home, engage in household tasks, and take care of their younger siblings (Eng & Szmodis, 2015). Furthermore, there are fewer female than male science and mathematics teachers in Cambodia, which may be a factor related with female role model, it could contribute to female students' low motivation to participate in science-related activities. In contrast, male students have more access to extracurricular activities outside the home, which may enhance their positive attitude towards science, as the present study has shown (Kao, 2021). Males' tendency towards a positive orientation might, in turn, affect how well they perform in science and their attitude towards science. Male students tend to have a higher science self-concept than female students. Males may not initially choose the science track in secondary school, but they are more willing than females to eventually choose a STEM major in a higher grade or undertake a STEM career in their professional life because of their higher self-esteem in terms of their science and mathematics competencies, compared to females.

Therefore, to increase female interest in STEM, we need to pay more attention to increasing female students' engagement with science and mathematics as well as with other subjects related to STEM in lower grades in preparation for their decision making in higher grades. Female students at a lower grade also need to be more involved in extracurricular activities to ensure that they can perform well in science subjects. Male teachers should pay more attention to female students in an effort to motivate them to participate in science-related activities. Increasing the number of females who gravitate towards sciences and mathematics is another challenge that policymakers and MoEYS need to tackle in order to enhance academic science performance and the prevalence of positive attitudes towards science among female students. Parents' involvement is also an important factor in whether female students perform well in science subjects. When female students have higher self-concepts in science and mathematics, they will be more inclined to choose a STEM major or career, like their male counterparts.

This study has revealed practical implications to inform relevant stakeholders, educators, career counsellors, and policymakers about the factors and barriers operating in upper secondary education in the Cambodian context. It is time to empower students to choose their higher education path (i.e., the educational stage where students prepare for a career). We need to investigate the factors influencing both male female secondary school students' career choice in Cambodia, but because female students face more challenges regarding entering STEM fields than male students, we should pay attention to female students in order to provide helpful career advice or counselling. To increase the attention being paid to STEM career choice at the secondary school level in Cambodia, as well as in other developing countries, with the goal of providing students with effective career counselling or informal advice, students must be guided to develop clear career plans and stronger views about their future professional life. For instance, choosing the right upper secondary school stream/track (science vs. social science) could be greatly advantageous to students as it is related to selecting a major at the higher education stage as well as to their ultimate career choice. Once they make a wrong decision in their education, it will ruin their future career. Moreover, parents should get involved in their children's school activities and in their children's education in general.

8.3 Further studies

Due to the time constraints on this research as well as to the global education situation, the current study, which was conducted during the Covid-19 pandemic, faced the fact that most schools were closed due to lockdown in an effort to control viral spread. Therefore, the researcher would like to suggest that further research administer a questionnaire to students face to face, so that the researcher can explain the questionnaire and the objective of the research to the participating students, who can ask for clarification about any of the survey items. The present research was conducted online; therefore, the response rate was low, and the number of respondents did not reach the number the researcher wanted. The researcher would therefore recommend that further research increase the sample size because some statistical analyses need a certain number of samples to run the analysis. In this study, some variables were newly developed to adapt to the change in the global education situation. Since they are new, those variables were not found to be significant, as students might not have been familiar with them. Moreover, the current study could only examine the factors influencing upper secondary school students' STEM career choices from the perspective of their intended career choice. Additionally, it is important to note that career counselling is not available in Cambodia. Therefore, the students' career choices might not have been clear or well-made decisions. Furthermore, to gain a deeper understanding of the differences between the factors influencing male and female students' STEM career choices, future studies should conduct further analysis of the interaction between gender and other factors influencing students' career choices.

Since STEM has not yet been widely introduced in Cambodia and given that Cambodia is still a developing country, this study could not treat the term 'STEM occupation' as meaning professional scientists. If the study had applied that definition, the results might have been biased or different from the findings reported in this paper because the respondents would not have interpreted the term 'STEM occupation' to mean being a professional scientist or having advanced professional skills in STEM subjects.

In future studies, the researcher would recommend increasing the sample size because the weighted sample analysis conducted in the present study revealed more variables that significantly influenced upper secondary school students' STEM career choices than the analysis of the original sample. Finally, the current study focused on general education. The researcher would suggest that future studies focus on TVET students.

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APPENDICES

Appendix 1: List of STEM Career from STEM careers of the future by MoEYS & British embassy, 2016

No.	STEM Career
1	Production Line supervisor
2	Automation Technician
3	Architect
4	Civil engineer
5	Construction site supervisor
6	Health & safety engineer
7	Project manager
8	Water supply expert
9	Water sanitation Expert
10	Quality assurance specialist
11	Chemist
12	Public health analyst
13	Doctor
14	Medical Laboratory technician
15	Psychologist
16	Economist
17	Actuary
18	Financial analyst
19	Mechanic
20	Network analyst
21	Software program

Appendix 2: STEM categorization and major fields of study (Kao, 2021)

STEM Categorization	Major Field of Study	CIP Major List	Remarks
Natural Science	Agriculture, agriculture operations, and related sciences	- Agriculture, General - Agricultural business and management - Agricultural Mechanization - Agricultural Production Operations - Agricultural and Food Products Processing - Agricultural and Domestic Animal Services - Applied Horticulture and Horticultural Business Services - International Agriculture - Agricultural Public Services - Animal Sciences - Food Science and Technology - Plant Sciences - Soil Sciences - Agriculture, Agriculture Operations, and Related Sciences	
	Natural resources and conservation	- Natural Resources Conservation and Research - Natural Resources Management and Policy	

		- Fishing and Fisheries Science and Management - Forestry - Wildlife and Wildlands Science and Management - Natural Resources and Conservation, other
	Biological and biomedical sciences	- Biology, General - Biochemistry, Biophysics and Molecular Biology - Botany/Plant Biology - Cellular Biology and Anatomical Sciences - Microbiological Sciences and Immunology - Zoology/Animal Biology - Genetics - Physiology, Pathology, and Related Sciences - Pharmacology and Toxicology - Biomathematics, Bioinformatics, and Computational Biology - Biotechnology - Ecology, Evolution, Systematics, and Population Biology

		- Molecular Medicine - Neurobiology and Neurosciences - Biological and Biomedical Sciences, other
	Physical science	- Physical Science - Astronomy and Astrophysics - Atmospheric Sciences and Meteorology - Chemistry - Geological and Earth Science/Geosciences - Physics - Material Science - Physical Sciences, other
	Science technologies and technicians	- Science Technologies/Technicians, General - Biology Technician/Biotechnology Laboratory Technician - Nuclear and Industrial Radiologic Technologies/Technicians - Physical Science Technologies/Technicians - Science Technologies/Technicians, other
Computer and information sciences	Computer and information sciences and support services	- Computer and Information Sciences, General - Computer Programming

		- Data Processing - Information Science/Studies - Computer Systems Analysis - Data Entry/Microcomputer Applications - Computer Science - Computer Software and Media Applications - Computer System Networking and Telecommunications - Computer/Information Technology Administration and Management - Computer and Information Sciences and Support Services, Others
Engineering and engineering technology	Engineering	- Engineering, General - Aerospace, Aeronautical and Astronautical Engineering - Agricultural Engineering - Architectural Engineering - Biomedical/Medical Engineering - Ceramic Sciences and Engineering - Chemical Engineering - Civil Engineering

	- Computer Engineering - Electrical, Electronics and Communications Engineering - Engineering Mechanics - Engineering Physics - Engineering Sciences - Environmental/Environmental Health Engineering - Material Engineering - Mechanical Engineering - Metallurgical Engineering - Mining and Mineral Engineering - Naval Architecture and Marines Engineering - Nuclear Engineering - Ocean Engineering - Petroleum Engineering - Systems Engineering - Textile Sciences and Engineering - Polymer/Plastics Engineering - Construction engineering - Forest Engineering - Industrial Engineering

		- Manufacturing Engineering - Geological/Geographical Engineering - Paper Science and Engineering - Electromechanical Engineering - Mechatronics, Robotics, and Automation Engineering - Biochemical Engineering - Engineering Chemistry - Biological/Biosystems Engineering - Engineering, Others
	Engineering technologies and engineering-related fields	- Engineering Technology, General - Architectural Engineering Technologies/Technicians - Civil Engineering Technologies/Technicians - Electrical Engineering Technologies/Technicians - Electromechanical Instrumentation and Maintenances Technologies - Environmental Control Technologies - Industrial Production Technologies - Quality Control and Safety Technologies

		- Mechanical Engineering Related Technologies - Mining and Petroleum Technologies - Construction Engineering Technologies - Drafting/Design Engineering Technologies - Nanotechnology
Mathematics	Mathematics and statistics	- Mathematics - Statistics - Practical Statistics Management - Practical Mathematics - Mathematics and Statistics, Other

Source: Synthesis of National Center for Education Statistics [NCES] (2020), Ministry of Education, Youth and Sport (2020), and extant literature on STEM majors in higher education.

Appendix 3: Frequency table of all items

All respondents	Frequency	Percentage
Career Choice ***(missing 16 samples)***		
STEM	85	50.9
Non-STEM	82	49.1
Gender		
Male	131	71.6
Female	52	28.4
Existing career plan		
Yes	146	79.8
No	37	20.2
Upper Secondary School Stream		
Science	104	56.8
Social	79	43.2
STEM ability and achievement		
Science ability and achievement		
I am able get a good grade in my science class		
Strongly agree	7	3.8
Agree	67	36.6
Normal	90	49.2
Disagree	17	9.3
Strongly disagree	2	1.1
I am able to complete my science homework		
Strongly agree	8	4.4
Agree	80	43.7
Normal	77	42.1
Disagree	16	8.7
Strongly disagree	2	1.1
I will work hard in my science class		

Strongly agree	36	19.7
Agree	104	56.8
Normal	35	19.1
Disagree	7	3.8
Strongly disagree	1	0.5
I like my science class		
Strongly agree	26	14.2
Agree	73	39.9
Normal	66	36.1
Disagree	13	8.7
Strongly disagree	2	1.1
I take private class for science		
Strongly agree	34	18.6
Agree	103	56.3
Normal	36	19.7
Disagree	10	5.5
Strongly disagree	0	0
Technology ability and achievement		
I am able to do well in activities that involve technology		
Strongly agree	4	2.2
Agree	47	25.7
Normal	107	58.5
Disagree	23	12.6
Strongly disagree	2	1.1
I am able to learn new technology		
Strongly agree	8	4.4
Agree	69	37.7
Normal	91	49.7
Disagree	14	7.7

Strongly disagree	1	0.5
I will learn about new technologies that will help me with school		
Strongly agree	14	7.7
Agree	129	70.5
Normal	39	21.3
Disagree	1	0.5
Strongly disagree	0	0
I like to use technology for class work		
Strongly agree	13	7.1
Agree	74	40.0
Normal	84	45.9
Disagree	11	6
Strongly disagree	1	0.5
I am able to explain other about technology		
Strongly agree	3	1.6
Agree	49	26.8
Normal	99	54.1
Disagree	30	16.4
Strongly disagree	2	1.1
Engineering ability and achievement		
I am able to do well in activities that involve engineering		
Strongly agree	3	1.6
Agree	18	9.8
Normal	94	51.4
Disagree	64	35
Strongly disagree	4	2.2
I am able to learn new engineering		
Strongly agree	2	1.1
Agree	32	17.5

Normal	90	49.2
Disagree	56	30.6
Strongly disagree	3	1.6
I will learn about new engineering that will help me with school		
Strongly agree	6	3.3
Agree	72	39.3
Normal	75	41
Disagree	28	15.3
Strongly disagree	2	1.1
I like to use engineering for class work		
Strongly agree	1	0.5
Agree	35	19.1
Normal	95	51.9
Disagree	49	26.8
Strongly disagree	3	1.6
I am able to explain other about engineering		
Strongly agree	3	1.6
Agree	17	9.3
Normal	93	50.8
Disagree	66	36.1
Strongly disagree	4	2.2
Mathematics ability and achievement		
I am able get a good grade in my Mathematics class		
Strongly agree	12	6.6
Agree	48	26.2
Normal	101	55.2
Disagree	19	10.4
Strongly disagree	3	1.6

I am able to complete my Mathematics homework		
Strongly agree	11	6
Agree	72	39.3
Normal	83	45.4
Disagree	16	8.7
Strongly disagree	1	0.5
I will work hard in my Mathematics class (missing 1 sample)		
Strongly agree	37	20.3
Agree	115	63.2
Normal	26	14.3
Disagree	3	1.6
Strongly disagree	1	0.5
I like my Mathematics class		
Strongly agree	23	12.6
Agree	88	48.1
Normal	62	33.9
Disagree	10	5.5
Strongly disagree	0	0
I take private class for Mathematics.		
Strongly agree	42	23
Agree	104	56.8
Normal	29	15.8
Disagree	6	3.3
Strongly disagree	2	1.1
STEM learning self-efficacy		
Science learning self-efficacy		
I can obtain good grades in science subjects		
Strongly agree	9	4.9
Agree	62	33.9

Normal	92	50.3
Disagree	19	10.4
Strongly disagree	1	0.5
I can solve problems related to science concepts well (missing 1 sample)		
Strongly agree	3	1.6
Agree	39	21.4
Normal	116	63.7
Disagree	23	12.6
Strongly disagree	1	0.5
I can write laboratory reports (experimental reports) correctly (missing 1 sample)		
Strongly agree	2	1.1
Agree	43	23.6
Normal	101	55.5
Disagree	34	18.7
Strongly disagree	2	1.1
I can collect information on scientific concepts properly (missing 1 sample)		
Strongly agree	2	1.1
Agree	38	20.9
Normal	102	56
Disagree	38	20.9
Strongly disagree	2	1.1
I am sure that I can carry out scientific experiments in the laboratory properly (missing 1 sample)		
Strongly agree	2	1.1
Agree	52	28.6
Normal	91	50

Disagree	37	20.3
Strongly disagree	0	0
Technology learning self-efficacy		
I can download an image or video from the internet (missing 1 sample)		
Strongly agree	24	13.2
Agree	102	56
Normal	48	26.4
Disagree	8	4.4
Strongly disagree	0	0
I can handle everyday technological products easily (e.g., blender, microwave, toaster, rice cooker) (missing 1 sample)		
Strongly agree	36	19.8
Agree	91	50
Normal	45	24.7
Disagree	9	4.9
Strongly disagree	1	0.5
I can use the computer properly (missing 1 sample)		
Strongly agree	8	4.4
Agree	47	25.8
Normal	95	52.2
Disagree	30	16.5
Strongly disagree	2	1.1
I can handle digital devices properly (e.g., smartphone, iPad, tablet) (missing 1 sample)		
Strongly agree	21	11.5
Agree	79	43.4
Normal	71	39
Disagree	9	4.9

Strongly disagree	2	1.1
I can social media properly (Facebook, Instagram, Twitter) (missing 1 sample)		
Strongly agree	26	14.3
Agree	97	53.3
Normal	52	28.6
Disagree	7	3.8
Strongly disagree	0	0
Engineering learning self-efficacy		
I am sure that I can build robot from Lego (missing 1 sample)		
Strongly agree	5	2.7
Agree	20	11
Normal	49	26.9
Disagree	99	54.4
Strongly disagree	9	4.9
I can use welding tools properly (missing 2 samples)		
Strongly agree	5	2.8
Agree	11	6.1
Normal	51	28.2
Disagree	104	57.2
Strongly disagree	10	5.5
I can assemble furniture (missing 2 samples)		
Strongly agree	6	3.3
Agree	32	17.7
Normal	56	30.9
Disagree	79	43.6
Strongly disagree	8	4.4
I can build electronic circuits (missing 1 sample)		
Strongly agree	4	2.2

Agree	22	12.1
Normal	49	26.9
Disagree	91	50
Strongly disagree	16	8.8
I can repair a broken toy (missing 1 sample)		
Strongly agree	10	5.5
Agree	57	31.3
Normal	83	45.6
Disagree	30	16.5
Strongly disagree	2	1.1
Mathematic learning self-efficacy		
I can obtain good grades in mathematics subjects (missing 1 sample)		
Strongly agree	7	3.8
Agree	54	29.7
Normal	97	53.3
Disagree	24	13.2
Strongly disagree	0	0
I am confident that I can record data accurately (missing 1 sample)		
Strongly agree	4	2.2
Agree	67	36.8
Normal	100	54.9
Disagree	11	6
Strongly disagree	0	0
I can draw a graph from the provided data (missing 1 sample)		
Strongly agree	4	2.2
Agree	53	29.1
Normal	97	53.5

Disagree	28	15.4
Strongly disagree	0	0
I am competent in using scientific calculators (missing 1 sample)		
Strongly agree	9	4.9
Agree	65	35.7
Normal	92	50.5
Disagree	16	8.8
Strongly disagree	0	0
I can solve mathematical problem properly (missing 1 sample)		
Strongly agree	4	2.2
Agree	35	19.2
Normal	113	62.1
Disagree	29	15.9
Strongly disagree	1	0.5
Interest in STEM career		
I plan to use science in my future career (missing 1 sample)		
Strongly agree	20	11
Agree	82	45.1
Normal	67	36.8
Disagree	11	6
Strongly disagree	2	1.1
If I do well in science classes, it will help me in my future career (missing 1 sample)		
Strongly agree	32	17.6
Agree	108	59.3
Normal	34	18.7
Disagree	7	3.8
Strongly disagree	1	0.5

I am interested in careers that use science (missing 2 samples)		
Strongly agree	19	10.5
Agree	87	48.1
Normal	67	37
Disagree	8	4.4
Strongly disagree	0	0
I would feel comfortable talking to people who work in science careers (missing 1 sample)		
Strongly agree	22	12.1
Agree	76	41.8
Normal	77	42.3
Disagree	6	3.3
Strongly disagree	1	0.5
I know of someone in my family who used science in their career (missing 1 sample)		
Strongly agree	12	6.6
Agree	39	21.4
Normal	66	36.3
Disagree	60	33
Strongly disagree	5	2.7
Interest in technology career		
I plan to use technology in my future career (missing 1 sample)		
Strongly agree	15	8.2
Agree	70	38.5
Normal	85	46.7
Disagree	12	6.6
Strongly disagree	0	0
If I learn a lot about technology, I will be able to do lots of different types of careers (missing 1 sample)		

Strongly agree	22	12.1
Agree	104	57.1
Normal	50	27.5
Disagree	6	3.3
Strongly disagree	0	0
I am interest in careers that use technology (missing 1 sample)		
Strongly agree	16	8.8
Agree	74	40.7
Normal	81	44.5
Disagree	11	6
Strongly disagree	0	0
I would feel comfortable talking to people who work in technology careers (missing 1 sample)		
Strongly agree	16	8.8
Agree	71	39
Normal	87	47.8
Disagree	7	3.8
Strongly disagree	1	0.5
I know of someone in my family who used technology in their career (missing 1 sample)		
Strongly agree	9	4.9
Agree	45	24.7
Normal	78	42.9
Disagree	44	24.2
Strongly disagree	6	3.3
Interest in engineering career		
I plan to use engineering in my future career (missing 1 sample)		
Strongly agree	9	4.9
Agree	37	20.3

Normal	85	46.7
Disagree	48	26.4
Strongly disagree	3	1.6
If I learn a lot about engineering, I will be able to do lots of different types of careers (missing 1 sample)		
Strongly agree	15	8.2
Agree	68	37.4
Normal	70	38.5
Disagree	25	13.7
Strongly disagree	4	2.2
I am interested in careers that involve engineering (missing 1 sample)		
Strongly agree	9	4.9
Agree	42	23
Normal	93	50.8
Disagree	34	18.6
Strongly disagree	4	2.2
I would feel comfortable talking to people who are engineer (missing 1 sample)		
Strongly agree	10	5.5
Agree	46	25.3
Normal	101	55.5
Disagree	22	12.1
Strongly disagree	3	1.6
I know of someone in my family who are engineer (missing 1 sample)		
Strongly agree	3	1.6
Agree	29	15.9
Normal	80	44

Disagree	65	35.7
Strongly disagree	5	2.7
Interest in mathematic career		
I plan to use mathematics in my future career (missing 1 sample)		
Strongly agree	10	5.5
Agree	80	44
Normal	74	40.7
Disagree	17	9.3
Strongly disagree	1	0.5
If I do well in mathematics classes, it will help me in my future career (missing 1 sample)		
Strongly agree	31	17
Agree	86	47.3
Normal	57	31.3
Disagree	8	4.4
Strongly disagree	0	0
I am interested in careers that use mathematics (missing 2 samples)		
Strongly agree	12	6.6
Agree	82	45.3
Normal	79	43.6
Disagree	8	4.4
Strongly disagree	0	0
I would feel comfortable talking to people who work in mathematics careers (missing 1 sample)		
Strongly agree	18	9.9
Agree	74	40.7
Normal	80	44

Disagree	10	5.5
Strongly disagree	0	0
I know of someone in my family who used mathematics in their career (missing 1 sample)		
Strongly agree	11	6
Agree	60	33
Normal	74	40.7
Disagree	33	18.1
Strongly disagree	4	2.2
Order of childhood		
Alone	5	2.7
Youngest	65	35.5
Middle	57	31.1
Oldest	56	30.6
Type of guardian		
Live alone or with non-parents	30	16.4
Live with parents	153	83.6
Male guardian education ***(missing 1 sample)***		
No male guardian education	31	17
No education	8	4.4
Primary school	32	17.6
Lower secondary	50	27.5
Upper secondary	39	21.4
Bachelor	15	8.2
Master	7	3.8
Other	0	0
Female guardian education		
No male guardian education	2	1.1
No education	22	12

Primary school	55	30.1
Lower secondary	49	26.8
Upper secondary	34	18.6
Bachelor	28	4.4
Master	2	1.1
Other	11	6
Male guardian occupation *(missing 38 samples)*		
STEM	21	14.5
Non-STEM	124	85.5
Female guardian occupation *(missing 23 samples)*		
STEM	6	3.8
Non-STEM	154	96.3
Family income *(missing 1 sample)*		
Lower than 200USD	95	52.2
200-400USD	52	28.6
400-600USD	16	8.8
Over 600USD	19	10.4
Gender equality in the family		
My family members treat me the same as male siblings in the family (missing 1 sample)		
Strongly agree	13	7.1
Agree	41	22.5
Normal	97	53.3
Disagree	27	14.8
Strongly disagree	4	2.2
My relatives treat me the same as male siblings in the family (missing 2 samples)		
Strongly agree	14	7.7
Agree	44	24.3

Normal	92	50.8
Disagree	26	14.4
Strongly disagree	5	2.8
I have an equal opportunity to go to school and choose a major I like as my male sibling (missing 2 samples)		
Strongly agree	46	25.4
Agree	93	51.4
Normal	35	19.3
Disagree	5	2.8
Strongly disagree	2	1.1
I have an equal opportunity to choose my career as my male sibling (missing 2 samples)		
Strongly agree	48	26.5
Agree	89	49.2
Normal	32	17.7
Disagree	9	5
Strongly disagree	3	1.7
My family encourages me to get good grades in science and mathematics subjects (missing 2 samples)		
Strongly agree	26	14.4
Agree	74	40.9
Normal	68	37.6
Disagree	11	6.1
Strongly disagree	2	1.1
Guardian influence on STEM		
My male guardian has influenced my choice of STEM as a career (missing 4 samples)		
Strongly agree	2	1.1
Agree	37	20.7

Normal	113	63.1
Disagree	24	13.4
Strongly disagree	3	1.7
My female guardian has influenced my choice of STEM as a career (missing 2 samples)		
Strongly agree	5	2.8
Agree	44	24.3
Normal	112	61.9
Disagree	20	11
Strongly disagree	0	0
My male guardian encourages me to choose a career in STEM (missing 4 samples)		
Strongly agree	8	4.5
Agree	57	31.8
Normal	100	55.9
Disagree	14	7.8
Strongly disagree	0	0
My female guardian encourages me to choose a career in STEM (missing 2 samples)		
Strongly agree	13	7.2
Agree	53	29.3
Normal	103	56.9
Disagree	12	6.6
Strongly disagree	0	0
My male guardian discourages me to choose a career in STEM (missing 4 samples)		
Strongly agree	1	0.6
Agree	6	3.4
Normal	61	34.1

Disagree	86	48
Strongly disagree	25	14
My female guardian discourages me to choose a career in STEM (missing 2 samples)		
Strongly agree	3	1.7
Agree	7	3.9
Normal	62	34.3
Disagree	84	46.4
Strongly disagree	25	13.8
My male guardian's career had an impact on my choice of career in STEM (missing 4 samples)		
Strongly agree	1	0.6
Agree	29	16.2
Normal	108	60.3
Disagree	38	21.2
Strongly disagree	3	1.7
My female guardian's career had an impact on my choice of career in STEM (missing 3 samples)		
Strongly agree	1	0.6
Agree	29	16.1
Normal	110	61.1
Disagree	37	20.6
Strongly disagree	3	1.7
Information I got from my male guardian helped me to choose a career in STEM (missing 4 samples)		
Strongly agree	11	6.1
Agree	64	35.8
Normal	96	53.6
Disagree	7	3.9

Strongly disagree	1	0.6
Information I got from my female guardian helped me to choose a career in STEM (missing 2 samples)		
Strongly agree	12	6.6
Agree	72	39.8
Normal	90	49.7
Disagree	7	3.9
Strongly disagree	0	0
STEM-related activities		
I join STEM-related clubs in school (missing 2 samples)		
Always	11	6
Very often	60	33
Often	74	40.7
Sometimes	33	18.1
Never	4	2.2
I participate in a STEM festival (missing 1 sample)		
Always	10	5.5
Very often	0	0
Often	7	3.9
Sometimes	96	53
Never	68	37.6
I visited a STEM festival (missing 1 sample)		
Always	4	2.2
Very often	1	0.5
Often	4	2.2
Sometimes	98	53.8
Never	75	41.2
I participate in a STEM-related competition (missing 2 samples)		
Always	6	3.3

Very often	0	0
Often	3	1.7
Sometimes	43	23.8
Never	129	71.3
I visit research centers at factories or at universities (missing 2 samples)		
Always	3	1.7
Very often	1	0.6
Often	6	3.3
Sometimes	62	34.3
Never	109	60.2
Access to national career day		
I attend National Career Day (missing 1 sample)		
Strongly agree	8	4.4
Agree	38	20.9
Normal	72	39.6
Disagree	34	18.7
Strongly disagree	30	16.5
I get a lot of information about my career on National career day (missing 1 sample)		
Strongly agree	9	4.9
Agree	49	26.9
Normal	71	39
Disagree	35	19.2
Strongly disagree	18	9.9
I choose a career based on information I get from National career day (missing 1 sample)		
Strongly agree	4	2.2
Agree	46	25.3

Normal	71	39
Disagree	49	26.9
Strongly disagree	12	6.6
National career day has influenced my career choice (missing 1 sample)		
Strongly agree	7	3.8
Agree	59	32.4
Normal	79	43.4
Disagree	32	17.6
Strongly disagree	5	2.7
National career day is very useful (missing 1 sample)		
Strongly agree	34	18.7
Agree	81	44.5
Normal	59	32.4
Disagree	5	2.7
Strongly disagree	3	1.6
Teacher encouragement		
Teacher actively encourages me to consider a wide range of career choices including those that are non-traditional (missing 1 sample)		
Strongly agree	28	15.4
Agree	96	52.7
Normal	53	29.1
Disagree	4	2.2
Strongly disagree	1	0.5
Lack of laboratory equipment in our school made me drop science (missing 1 sample)		
Strongly agree	9	4.9
Agree	40	22

Normal	46	25.3
Disagree	75	41.2
Strongly disagree	12	6.6
Generally, teachers treat male and female students the same (missing 1 sample)		
Strongly agree	66	36.6
Agree	81	44.5
Normal	28	15.4
Disagree	6	3.3
Strongly disagree	1	0.5
Teachers expect the same achievement from females and males (missing 1 sample)		
Strongly agree	67	36.8
Agree	85	46.7
Normal	26	14.3
Disagree	3	1.6
Strongly disagree	1	0.5
Teachers point out examples of stereotyping in textbooks and other materials (missing 1 sample)		
Strongly agree	6	3.3
Agree	28	15.5
Normal	46	25.4
Disagree	78	43.1
Strongly disagree	23	12.7
Impact of online learning on STEM		
I can do better in science and mathematics when I have online classes (missing 1 sample)		
Strongly agree	4	2.2
Agree	19	10.4

Normal	84	46.2
Disagree	61	33.5
Strongly disagree	14	7.7
I changed my career choice from non-STEM related to STEM because of online classes (missing 2 samples)		
Strongly agree	1	0.6
Agree	15	8.3
Normal	96	53
Disagree	59	32.6
Strongly disagree	10	5.5
I changed my career choice from STEM to non-STEM related because of online classes (missing 4 samples)		
Strongly agree	2	1.1
Agree	12	6.7
Normal	93	52
Disagree	63	35.2
Strongly disagree	9	5
I have difficulty studying online classes with science and mathematics subjects (missing 4 samples)		
Strongly agree	31	17.3
Agree	75	41.9
Normal	57	31.8
Disagree	6	3.4
Strongly disagree	10	5.6
Online class influences my career choice in STEM (missing 5 samples)		
Strongly agree	7	3.9
Agree	44	24.7
Normal	75	42.1

Disagree	42	23.6
Strongly disagree	10	5.6
Gender stereotypes		
There are careers suitable for men and others suitable for women (missing 3 samples)		
Strongly agree	5	2.8
Agree	58	32.2
Normal	35	19.4
Disagree	66	36.7
Strongly disagree	16	8.9
Male students have higher career ambitions than girls (missing 3 samples)		
Strongly agree	2	1.1
Agree	21	11.7
Normal	28	15.6
Disagree	102	56.7
Strongly disagree	27	15
Boys and girls were socialized to choose careers that are gender sensitive (missing 3 samples)		
Strongly agree	9	5
Agree	65	36.1
Normal	35	19.4
Disagree	63	35
Strongly disagree	8	4.4
Women's role is homemaker and male's role are breadwinner (missing 2 samples)		
Strongly agree	4	2.2
Agree	11	6.1
Normal	22	12.2

Disagree	71	39.2
Strongly disagree	73	40.3
Boys can use computers more effectively to solve problems than girls (missing 4 samples)		
Strongly agree	1	0.6
Agree	17	9.5
Normal	26	14.5
Disagree	99	55.3
Strongly disagree	36	20.1
Female role model		
Male role models have influenced me to take the career I want to pursue (missing 3 samples)		
Strongly agree	5	2.8
Agree	39	21.7
Normal	87	48.3
Disagree	44	24.4
Strongly disagree	5	2.8
Female role models have influenced me to choose the career I want to do (missing 3 samples)		
Strongly agree	13	7.2
Agree	54	30
Normal	84	46.7
Disagree	26	14.4
Strongly disagree	3	1.7
I value career advice I get from same sex friends (missing 3 samples)		
Strongly agree	10	5.6
Agree	49	27.2
Normal	85	47.2

Disagree	31	17.2
Strongly disagree	5	2.8
I have a female professional as my role model (missing 3 samples)		
Strongly agree	11	6.1
Agree	83	46.1
Normal	70	38.9
Disagree	13	7.2
Strongly disagree	3	1.7
I have a female mentor guide me for career choice (missing 4 samples)		
Strongly agree	8	4.5
Agree	62	34.6
Normal	79	44.1
Disagree	29	16.2
Strongly disagree	1	0.6
Advice for STEM career choice		
I get advice from my teacher to choose a career in STEM (missing 4 samples)		
Strongly agree	11	6.1
Agree	92	51.4
Normal	64	35.8
Disagree	9	5
Strongly disagree	3	1.7
I get advice from former students to choose a career in STEM (missing 4 samples)		
Strongly agree	5	2.8
Agree	59	33
Normal	82	45.8

Disagree	30	16.8
Strongly disagree	3	1.7
I get advice from my classmates to choose a career in STEM (missing 4 samples)		
Strongly agree	6	3.4
Agree	49	27.4
Normal	92	51.4
Disagree	28	15.6
Strongly disagree	4	2.2
Advice from others influenced my career choice in STEM (missing 5 samples)		
Strongly agree	3	1.7
Agree	47	26.4
Normal	100	56.2
Disagree	23	12.9
Strongly disagree	5	2.8
I choose a career in STEM by myself (missing 5 samples)		
Strongly agree	21	11.8
Agree	55	30.9
Normal	87	48.9
Disagree	14	7.9
Strongly disagree	1	0.6

Appendix 4: Frequency, Mean and Standard Deviation table of computed variables

Variables	Frequency	Valid Percentage	Mean	SD
STEM ability and Achievement			2.8	0.5
Less than 2	0	0		
2 to 3	39	21.3		
3 to 4	135	73.8		
4 or above	9	4.9		
STEM learning self-efficacy			2.7	0.6
Less than 2	0	0		
2 to 3	70	38.3		
3 to 4	105	57.4		
4 or above	7	3.8		
Interest in STEM career			2.9	0.6
Less than 2	1	0.5		
2 to 3	24	18.6		
3 to 4	124	57.8		
4 or above	23	12.6		
Gender equality in the family			2.8	0.7
Less than 2	6	3.3		
2 to 3	48	26.2		
3 to 4	101	55.2		
4 or above	27	14.8		
Guardian influence on STEM			2.5	0.6
Less than 2	2	1.1		
2 to 3	86	47.0		
3 to 4	87	47.5		
4 or above	6	3.3		
STEM-related activities			1.2	0.5

Less than 2	162	88.5		
2 to 3	14	7.7		
3 to 4	3	1.6		
4 or above	3	1.6		
Access to national career day			2.5	0.7
Less than 2	17	9.3		
2 to 3	73	39.9		
3 to 4	79	43.2		
4 or above	13	7.1		
Teacher encouragement			3.3	0.7
Less than 2	1	0.5		
2 to 3	21	11.5		
3 to 4	89	48.6		
4 or above	71	38.8		
Impact of online learning on STEM			1.9	0.6
Less than 2	38	20.8		
2 to 3	124	67.8		
3 to 4	19	10.4		
4 or above	1	0.5		
Gender stereotypes			2.5	0.6
Less than 2	112	61.2		
2 to 3	57	31.1		
3 to 4	10	5.5		
4 or above	2	1.1		
Female role model			2.6	0.6
Less than 2	4	2.2		
2 to 3	76	41.5		
3 to 4	87	47.5		

4 or above	13	7.1		
Advice for STEM career choice			2.6	0.6
Less than 2	6	3.3		
2 to 3	68	37.2		
3 to 4	96	52.5		
4 or above	9	4.9		

Appendix 5: Survey Questionnaire (English)

I. Personal information

Q1.1. Name:_________________ Q1.2. gender:_____ Q1.3.Year of birth:_________

Q1.4. Grade 12___________ Q1.5. School name:__________________

Q1.6. Phone number:_________________Q1.7. Facebook: ________________

Q1.8. Have you made a career choice? Yes ( ), No ( ) (If no, please skip question b & c)

Q1.9. Do you have any career plans at present? Yes ( ), No ( )

Q1.10. What do you want to be in the future?__________________________________

Q1.11. Among these 4 factors (1. Family, 2. Individual, 3. School, 4. Social), Which factor affect your future career choice? ______________________________________

II. Family background

Q2.1. Are you in the Social and Science track? 1. Social 2. Science

Q2.2. How many siblings do you have? How many male and female?

____

Q2.3. Which position are you among your siblings?

____

Q2.4. Who is your guardian or who do you live with (parents, siblings, or relatives)?

____

Q2.5. Male guardian's Highest educational level achieved:

0. No male guardian 1. No education ( ), 2. Primary school ( ), 3. High school ( ), 4. College ( ), 5. After college ( )

Q2.6. Female guardian's Highest educational level achieved:

0. No female guardian 1. No education ( ), 2. Primary school ( ), 3. High school ( ), 4. College ( ), 5. After college ( )

Q2.7. Male guardian's occupation:________________________,

Q2.8. Female guardian's occupation:______________________,

Q2.9. What is your family socioeconomic?

1. Less than 200USD 2. From 200-400USD 3. From 400-600USD 4. More than 600USD

Q2.10. Do you receive any scholarship? If yes, which scholarship?

____

Q2.11. Gender role socialization

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q2.11.1	My family members treat me the same as male siblings in the family.					
Q2.11.2	My relatives treat me the same as male siblings in the family.					
Q2.11.3	I have an equal opportunity to go to school and choose a major I like as my male sibling.					
Q2.11.4	I have an equal opportunity to choose my career as my male sibling.					
Q2.11.5	My family encourages me to get good grades in science and mathematics subjects.					

Q2.12. *Guardian influence*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q2.12.1	My male guardian has influenced my choice of STEM as a career.					
Q2.12.2	My female guardian has influenced my choice of STEM as a career.					
Q2.12.3	My male guardian encourages me to choose a career in STEM.					
Q2.12.4	My female guardian encourages me to choose a career in STEM.					
Q2.12.5	My male guardian discourages me to choose a career in STEM.					
Q2.12.6	My female guardian discourages me to choose a career in STEM.					
Q2.12.7	My male guardian’s career had an impact on my choice of career in STEM.					
Q2.12.8	My female guardian’s career had an impact on my choice of career in STEM.					

Q2.12.9	Information I got from my male guardian helped me to choose a career in STEM.					
Q2.12.10	Information I got from my female guardian helped me to choose a career in STEM.					

III. Individual

Q3.1. Science, mathematics, technology and Engineering ability and achievement

Please choose the Strongly disagree, disagree neutral agree and strongly agree to each statement based on your opinion.

a. *Science*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.1a.1	I am able to get a good grade in my science class.					
Q3.1a.2	I am able to complete my science homework.					
Q3.1a.3	I will work hard in my science class.					
Q3.1a.4	I like my science class.					
Q3.1a.5	I take private class for science.					

b. Technology

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.1b.1	I am able to do well in activities that involve technology.					
Q3.1b.2	I am able to learn new technology.					
Q3.1b.3	I will learn about new technologies that will help me with school.					
Q3.1b.4	I like to use technology for class work.					
Q3.1b.5	I am able to explain to others about technology.					

c. Engineering

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.1c.1	I am able to do well in activities that involve engineering.					
Q3.1c.2	I am able to learn new engineering.					
Q3.1c.3	I will learn about new engineering that will help me with school.					

Q3.1c.4	I like to use engineering for class work.					
Q3.1c.5	I am able to explain to others about engineering.					

d. Mathematics

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.1d.1	I am able to get a good grade in my Mathematics class.					
Q3.1d.2	I am able to complete my Mathematics homework.					
Q3.1d.3	I will work hard in my Mathematics class.					
Q3.1d.4	I like my mathematics class.					
Q3.1d.5	I take a private class for Mathematics.					

Q3.2. STEM learning Self-efficacy

Please choose the Strongly disagree, disagree neutral agree and strongly agree to each statement based on your opinion.

a. Science

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.2a.1	I can obtain good grades in science subjects.					

Q3.2a.2	I can solve problems related to science concepts well.					
Q3.2a.3	I can write laboratory reports (experimental reports) correctly.					
Q3.2a.4	I can collect information on scientific concepts properly.					
Q3.2a.5	I am sure that I can carry out scientific experiments in the laboratory properly.					

b. Technology

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.2b.1	I can download an image or video from the internet.					
Q3.2b.2	I can handle everyday technological products easily (e.g., blender, microwave, toaster, rice cooker).					
Q3.2b.3	I can use the computer properly.					
Q3.2b.4	I can handle digital devices properly (e.g., smartphone, iPad, tablet).					
Q3.2b.5	I can use social media properly (Facebook, Instagram, Twitter).					

c. Engineering

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.2c.1	I am sure that I can build a robot from Lego.					
Q3.2c.2	I can use welding tools properly.					
Q3.2c.3	I can assemble furniture.					
Q3.2c.4	I can build electronic circuits.					
Q3.2c.5	I can repair a broken toy.					

d. Mathematics

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.2d.1	I can obtain good grades in mathematics subjects.					
Q3.2d.2	I am confident that I can record data accurately.					
Q3.2d.3	I can draw a graph from the provided data.					
Q3.2d.4	I am competent in using scientific calculators.					
Q3.2d.5	I can solve mathematical problems properly.					

Q3.3. Interest in STEM Careers

Please choose the Strongly disagree, disagree neutral agree and strongly agree to each statement based on your opinion.

a. Science

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.3a.1	I plan to use science in my future career.					
Q3.3a.2	If I do well in science classes, it will help me in my future career.					
Q3.3a.3	I am interested in careers that use science.					
Q3.3a.4	I would feel comfortable talking to people who work in science careers.					
Q3.3a.5	I know of someone in my family who used science in their career.					

b. Technology

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.3b.1	I plan to use technology in my future career.					
Q3.3b.2	If I learn a lot about technology, I will be able to do lots of different types of careers.					
Q3.3b.3	I am interested in careers that use technology.					

Q3.3b.4	I would feel comfortable talking to people who work in technology careers.					
Q3.3b.5	I know of someone in my family who used technology in their career.					

c. Engineering

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.3c.1	I plan to use engineering in my future career.					
Q3.3c.2	If I learn a lot about engineering, I will be able to do lots of different types of careers.					
Q3.3c.3	I am interested in careers that involve engineering.					
Q3.3c.4	I would feel comfortable talking to people who are engineers.					
Q3.3c.5	I know of someone in my family who is an engineer.					

d. Mathematics

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q3.3d.1	I plan to use mathematics in my future career.					

Q3.3d.2	If I do well in mathematics classes, it will help me in my future career.					
Q3.3d.3	I am interested in careers that use mathematics.					
Q3.3d.4	I would feel comfortable talking to people who work in mathematics careers.					
Q3.3d.5	I know of someone in my family who used mathematics in their career.					

VI. School

Please choose the Strongly disagree, disagree neutral agree and strongly agree to each statement based on your opinion.

Q4.1. Activities outside classroom

No	*Items*	*Never*	*Sometimes*	*Often*	*Very often*	*Always*
Q4.1.1	I join STEM-related clubs in school.					
Q4.1.2	I participate in a STEM festival.					
Q4.1.3	I visited a STEM festival.					
Q4.1.4	I participate in a STEM-related competition.					
Q4.1.5	I visit research centers at factories or at universities.					

Q4.2. National career day

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q4.2.1	I attend National Career Day.					
Q4.2.2	I get a lot of information about my career on National career day.					
Q4.2.3	I choose a career based on information I get from National career day.					
Q4.2.4	National career day has influenced my career choice.					
Q4.2.5	National career day is very useful.					

Q4.3. *Educational climate*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q4.3.1	Teacher actively encourages me to consider a wide range of career choices including those that are non-traditional.					
Q4.3.2	Lack of laboratory equipment in our school made me drop science.					
Q4.3.3	Generally, teachers treat male and female students the same.					

Q4.3.4	Teachers expect the same achievement from females and males.					
Q4.3.5	Teachers point out examples of stereotyping in textbooks and other materials.					

Q4.4. *Online classes*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q4.4.1	I can do better in science and mathematics when I have online classes.					
Q4.4.2	I changed my career choice from non-STEM related to STEM because of online classes.					
Q4.4.3	I changed my career choice from STEM to non-STEM related because of online classes.					
Q4.4.4	I have difficulty studying online classes with science and mathematics subjects.					
Q4.4.5	Online class influences my career choice in STEM.					

Q4.4.6. Does online class influence your career choice in STEM or not? If yes, explain how it influences you.

____

VII. Environmental and social

Please choose the Strongly disagree, disagree neutral agree and strongly agree to each statement based on your opinion.

Q5.1. *Gender role*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q5.1.1	There are careers suitable for men and others suitable for women.					
Q5.1.2	Male students have higher career ambitions than girls.					
Q5.1.3	Boys and girls were socialized to choose careers that are gender sensitive.					
Q5.1.4	Women's role is homemaker and male's role are breadwinner.					
Q5.1.5	Boys can use computers more effectively to solve problems than girls.					

Q5.2. *Role model and mentor*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q5.2.1	Male models have influenced me to take the career I want to pursue.					
Q5.2.2	Female models have influenced me to choose the career I want to do.					
Q5.2.3	I value career advice I get from same sex friends.					
Q5.2.4	I have a female professional as my role model.					
Q5.2.5	I have a female mentor guide me for career choice.					

Q5.3. *Counselling and advising*

No	*Items*	*Strongly disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Q5.3.1	I get advice from my teacher to choose a career in STEM.					
Q5.3.2	I get advice from former students to choose a career in STEM.					
Q5.3.3	I get advice from my classmates to choose a career in STEM.					
Q5.3.4	Advice from others influenced my career choice in STEM.					
Q5.3.5	I choose a career in STEM by myself.					

Appendix 6: Survey Questionnaire (Khmer)

សួស្តីប្អូនៗទាំងអស់គ្នា!!!

ខ្ញុំឈ្មោះ **ស មុន្នីរ័ត្ន** ជានិស្សិតថ្នាក់បណ្ឌិតនៅសាលាក្រោយឧត្តមសម្រាប់ការអភិវឌ្ឍអន្តរជាតិ និងសហប្រតិបត្តិការ នៃសាកលវិទ្យាល័យហ៊ីរ៉ូស៊ីម៉ាប្រទេសជប៉ុន។ ខ្ញុំកំពុងធ្វើការសិក្សាស្រាវជ្រាវអំពីកត្តាជះឥទ្ធិពលលើការជ្រើសរើសមុខរបរសំរាប់អនាគតរបស់សិស្សស្រីក្នុងវិស័យវិទ្យាសាស្ត្រ បច្ចេកវិទ្យា វិស្វកម្ម និងគណិតវិទ្យា (STEM) នៃប្រទេសកម្ពុជា។ គោលបំណងសំខាន់នៃការសិក្សានេះគឺ ដើម្បីស្វែងរកកត្តានានាដែលមានឥទ្ធិពលលើការសម្រេចចិត្តជ្រើសរើសមុខរបរសំរាប់អនាគតរបស់សិស្សស្រីទាំងអស់ដែលកំពុងរៀននៅថ្នាក់ទី១២ និងបានជ្រើសរើសរៀនមុខវិជ្ជាវិទ្យាសាស្ត្រ។ ដើម្បីប្រមូលនូវព័ត៌មានដែលទាក់ទងនឹងកត្តានានាដែលមានឥទ្ធិពលលើការសម្រេចចិត្តជ្រើសរើសមុខរបរសំរាប់អនាគត និងព័ត៌មានទូទៅមួយចំនួន នៃការសិក្សាបានបង្ហាញថាការចូលរួម របស់ប្អូនៗទាំងអស់ពិតជាមានសារៈសំខាន់បំផុត ដើម្បីចូលរួមលើកកម្ពស់យ៉េនឌ័រ បង្កើនចំនួននិស្សិតចូលរៀន ក៏ដូចជាធនធាន- មនុស្សក្នុងវិស័យSTEM សម្រាប់បំពេញតម្រូវការទីផ្សារការងារបច្ចុប្បន្ន។

ព័ត៌មានផ្ទាល់ខ្លួនមួយចំនួននឹងត្រូវបានប្រមូល ប៉ុន្តែមិនថាក្នុងវិធីណាមួយ ការសិក្សានេះនឹងមិនរាយការណ៍នូវព័ត៌មានផ្ទាល់ខ្លួនរបស់បុគ្គលនីមួយៗឡើយ។ ដើម្បីរក្សាការសម្ងាត់ដល់អ្នកដែលបានចូលរួមបំពេញកម្រងសំណួរនេះ ការសិក្សានេះនឹងបង្ហាញតែលទ្ធផលរួមរបស់អ្នកចូលរួមទាំងអស់តែប៉ុណ្ណោះ។ ការចូលរួមរបស់អ្នកទាំងអស់គ្នាក៏ជាការស្ម័គ្រចិត្តផងដែរ។

ខ្ញុំពិតជាមានសេចក្តីរីករាយបំផុតដែលអ្នកទាំងអស់គ្នាបានចំណាយពេលវេលាដ៏មានតម្លៃក្នុងការបំពេញកម្រងសំណួរនេះ។ ប្រសិនបើអ្នកទាំងអស់គ្នាមានសំណួរអ្វីផ្សេងបន្ថែមទៀត សូមទំនាក់ទំនងមកខ្ញុំតាមរយៈ facebook page: Monyrath រឺ Email: sarmonyrath@yahoo.com។ សូមអរគុណសម្រាប់ការចូលរួមរបស់ប្អូនៗទាំងអស់គ្នា។

ដោយក្តីរាប់អាន

ស មុន្នីរ័ត្ន

និស្សិតថ្នាក់បណ្ឌិតផ្នែកអភិវឌ្ឍន៍ការអប់រំ សាកលវិទ្យាល័យហ៊ីរ៉ូស៊ីម៉ា ប្រទេសជប៉ុន

សូមផ្តល់នូវព័ត៌មានដូចខាងក្រោម ដោយធ្វើការ *គូសរង្វង់ជុំវិញចម្លើយ ឬ បំពេញចន្លោះ* ក្នុងករណីចាំបាច់។

I. ពត៌មានផ្ទាល់ខ្លួន

១. ឈ្មោះ______________ឆ្នាំកំណើត___________ភេទ_____

២. រៀនថ្នាក់ទី១២____សាលារៀន___________________លេខទូរស័ព្ទ_______________

៣. តើប្អូនបានសម្រេចចិត្តថានឹងធ្វើការងារអ្វីនាពេលអនាគតរួចហើយឬនៅ? (បើមិនទាន់សម្រេចចិត្តសូមរំលងសំណួរ៤ និង៥)

១. បាន ២. មិនបាន

៤. តើប្អូនមានផែនការទាក់ទងនឹងមុខរបរសំរាប់អនាគតទេ?

១. មាន ២. មិនមាន

៥. តើប្អូនចង់ធ្វើកាងារអ្វីនៅពេលរៀនចប់? __________________

៦. ក្នុងចំណោមកត្តាគ្រួសារ ផ្ទាល់ខ្លួន សាលារៀន សង្គម តើប្អូនគិតថាកត្តាមួយណាដែលជះឥទ្ធិពលដល់ការជ្រើសរើសមុខរបរសំរាប់អនាគតរបស់ប្អូន? ________________________________

II. ពត៌មានអំពីគ្រួសារ

១.តើប្អូនរៀនថ្នាក់សង្គម ឬថ្នាក់វិទ្យាសាស្រ្ត?

១. ថ្នាក់សង្គម ២. ថ្នាក់វិទ្យាសាស្រ្ត

២. តើប្អូនមានបងប្អូនបង្កើតចំនួនប៉ុន្មាននាក់? ស្រីប៉ុន្មាន? ប្រុសប៉ុន្មាន? ______ ស្រី___ ប្រុស__

៣. តើប្អូនជាកូនទីប៉ុន្មាន? ___________

៤. តើប្អូនរស់នៅជាមួយអ្នកណា? (ឧទាហរណ៍.ឪពុក ម្តាយ បង ពូ មីង....) _______

៥. កំរិតវប្បធម៌របស់អាណាព្យាបាលប្រុស៖

០.គ្មានអាណាព្យាបាលប្រុស ១.មិនបានរៀន ២.ចប់បឋមសិក្សា ៣.ចប់អនុវិទ្យាល័យ ៤.ចប់វិទ្យាល័យ ៥.ចប់បរិញ្ញាបត្រ ៦.ចប់អនុបណ្ឌិត ៧.ផ្សេងៗ

៦. កំរិតវប្បធម៌របស់អាណាព្យាបាលស្រី៖

០.គ្មានអាណាព្យាបាលស្រី ១.មិនបានរៀន ២.ចប់បឋមសិក្សា ៣.ចប់អនុវិទ្យាល័យ ៤.ចប់វិទ្យាល័យ ៥.ចប់បរិញ្ញាបត្រ ៦.ចប់អនុបណ្ឌិត ៧.ផ្សេងៗ

៧. មុខរបររបស់អាណាព្យាបាលប្រុស៖_____

៨. មុខរបររបស់អាណាព្យាបាលស្រី៖ ______

៩. តើប្រាក់ចំណូលគ្រួសាររបស់ប្អូនមានចំនួនប៉ុន្មានគិតជាមធ្យមក្នុងមួយខែ?

១. តិចជាង ២០០ដុល្លារ ២. ពី២០០–៤០០ដុល្លារ ៣. ពី៤០០–៦០០ដុល្លារ ៤. ច្រើនជាង ៦០០ដុល្លារ

១០. តើប្អូនបានទទួលបានអាហារូបករណ៍ដែររឺទេ? បើបានទទួល ជាអារូបករណ៍អ្វី?

១. បាន ប្រភេទអាហារូបករណ៍__________ ២. មិនបានទទួល

១១. ស្ថានភាពយេនឌ័រក្នុងគ្រួសារ

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	សមាជិកគ្រួសារខ្ញុំធ្វើដាក់ខ្ញុំដូចគាត់ធ្វើដាក់បងប្អូនប្រុសក្នុងគ្រួសារខ្ញុំដែរ					
២	សាច់ញ្ញាតិខ្ញុំធ្វើដាក់ខ្ញុំដូចគាត់ធ្វើដាក់បងប្អូនប្រុសក្នុងគ្រួសារខ្ញុំដែរ					
៣	ខ្ញុំទទួលបានឱកាសទៅសាលារៀន និងសម្រេចចិត្តលើការជ្រើសរើសមុខវិជ្ជាសំរាប់រៀន ដូចបងប្អូនប្រុសរបស់ខ្ញុំដែរ					

៤	ខ្ញុំទទួលបានឱកាសក្នុងការសម្រេចចិត្តលើការជ្រើសរើសអាជីពសំរាប់អនាគតដូចបងប្អូនប្រុសរបស់ខ្ញុំដែរ					
៥	គ្រួសាររបស់ខ្ញុំលើកទឹកចិត្តខ្ញុំអោយខំរៀនមុខវិជ្ជាវិទ្យាសាស្ត្រ និងគណិតវិទ្យា					

១២. ឥទ្ធិពលរបស់អាណាព្យាបាល

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	អាណាព្យាបាលប្រុសរបស់ខ្ញុំមានឥទ្ធិពលក្នុងសម្រេចចិត្តជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)					
២	អាណាព្យាបាលស្រីរបស់ខ្ញុំមានឥទ្ធិពលក្នុងសម្រេចចិត្តជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)					
៣	អាណាព្យាបាលប្រុសរបស់ខ្ញុំលើកទឹកចិត្តខ្ញុំឱ្យជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)					
៤	អាណាព្យាបាលស្រីរបស់ខ្ញុំលើកទឹកចិត្តខ្ញុំឱ្យជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)					

៥	អាណាព្យាបាលប្រុសរបស់ខ្ញុំរាំងខ្ញុំមិនឲ្យជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)ទេ					
៦	អាណាព្យាបាលស្រីរបស់ខ្ញុំរាំងខ្ញុំមិនឲ្យជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម (STEM)ទេ					
៧	អាណាព្យាបាលប្រុសរបស់ខ្ញុំមានឥទ្ធិពលលើការសម្រេចចិត្តជ្រើសយកអាជីពទាក់ទងនឹងស្ទែម(STEM)					
៨	អាណាព្យាបាលស្រីរបស់ខ្ញុំមានឥទ្ធិពលលើការសម្រេចចិត្តជ្រើសយកអាជីពទាក់ទងនឹងស្ទែម(STEM)					
៩	ព័ត៌មានដែលខ្ញុំទទួលបានពីអាណាព្យាបាលប្រុសមានប្រយោជន៍ដល់ខ្ញុំក្នុងការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					
១០	ព័ត៌មានដែលខ្ញុំទទួលបានពីអាណាព្យាបាលស្រីមានប្រយោជន៍ដល់ខ្ញុំក្នុងការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					

III. កត្តាផ្ទាល់ខ្លួន និងចិត្តសាស្ត្រ

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

1. សមត្ថភាព និងលទ្ធផលសិក្សា

ក. វិទ្យាសាស្រ្ត

ល.រ	ប្រយោគ	មិនយល់ស្របខ្លាំង	មិនយល់ស្រប	ធម្មតា	យល់ស្រប	យល់ស្របខ្លាំង
១	ខ្ញុំអាចទទួលបានពិន្ទុល្អសំរាប់មុខវិជ្ជាវិទ្យាសាស្រ្ត					
២	ខ្ញុំអាចធ្វើកិច្ចការផ្ទះមុខវិជ្ជាវិទ្យាសាស្រ្តបាន					
៣	ខ្ញុំនឹងខំរៀនមុខវិជ្ជាវិទ្យាសាស្រ្ត					
៤	ខ្ញុំចូលចិត្តរៀនមុខវិជ្ជាវិទ្យាសាស្រ្ត					
៥	ខ្ញុំរៀនគួរបន្ថែមសំរាប់មុខវិជ្ជាវិទ្យាសាស្រ្ត					

ខ. បច្ចេកវិទ្យា

ល.រ	ប្រយោគ	មិនយល់ស្របខ្លាំង	មិនយល់ស្រប	ធម្មតា	យល់ស្រប	យល់ស្របខ្លាំង
១	ខ្ញុំអាចធ្វើរាល់សកម្មភាពដែលទាក់ទងនឹងបច្ចេកវិទ្យា បានយ៉ាងល្អ					
២	ខ្ញុំមានសមត្ថភាពក្នុងការរៀនបច្ចេកវិទ្យាថ្មីៗ					
៣	ខ្ញុំនឹងរៀនអំពីបច្ចេកវិទ្យាថ្មីៗដែលអាចជួយដល់ការសិក្សារបស់ខ្ញុំ					
៤	ខ្ញុំចូលចិត្តប្រើបច្ចេកវិទ្យាសំរាប់ធ្វើកិច្ចការផ្ទះ					
៥	ខ្ញុំអាចពន្យល់អ្នកដ៏ទៃអំពីបច្ចេកវិទ្យាបាន					

គ. វិស្វកម្ម

ល.រ	ប្រយោគ	មិនយល់ស្របខ្លាំង	មិនយល់ស្រប	ធម្មតា	យល់ស្រប	យល់ស្របខ្លាំង
១	ខ្ញុំអាចធ្វើរាល់សកម្មភាពទាក់ទងនឹងវិស្វកម្មបានយ៉ាងល្អ					
២	ខ្ញុំមានសមត្ថភាពរៀនវិស្វកម្មថ្មីៗ					
៣	ខ្ញុំនឹងរៀនអំពីវិស្វកម្មថ្មីៗដែលអាចជួយដល់ការសិក្សារបស់ខ្ញុំ					
៤	ខ្ញុំចូលចិត្តប្រើវិស្វកម្មសំរាប់ធ្វើកិច្ចការផ្ទះ					
៥	ខ្ញុំអាចពន្យល់អ្នកដ៏ទៃអំពីវិស្វកម្មបាន					

ឃ. គណិតវិទ្យា

ល.រ	ប្រយោគ	មិនយល់ស្របខ្លាំង	មិនយល់ស្រប	ធម្មតា	យល់ស្រប	យល់ស្របខ្លាំង
១	ខ្ញុំអាចទទួលបានពិន្ទុល្អសំរាប់មុខវិជ្ជាគណិតវិទ្យា					
២	ខ្ញុំអាចធ្វើកិច្ចការផ្ទះមុខវិជ្ជាគណិតវិទ្យាបាន					
៣	ខ្ញុំនឹងខំរៀនមុខវិជ្ជាគណិតវិទ្យា					
៤	ខ្ញុំចូលចិត្តរៀនមុខវិជ្ជាគណិតវិទ្យា					
៥	ខ្ញុំរៀនគួរបន្ថែមសំរាប់មុខវិជ្ជាគណិតវិទ្យា					

3. ភាពជឿជាក់លើខ្លួនឯងក្នុងការរៀនមុខជំនាញស្ទែម (STEM)

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

ក. វិទ្យាសាស្ត្រ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំអាចទទួលបានពិន្ទុល្អសំរាប់មុខវិជ្ជាវិទ្យាសាស្ត្រ					
២	ខ្ញុំអាចដោះស្រាយបញ្ហាទាក់ទងនឹងវិទ្យាសាស្ត្របានយ៉ាងល្អ					
៣	ខ្ញុំអាចសរសេររបាយការណ៍ពិសោធន៍បានយ៉ាងត្រឹមត្រូវ					
៤	ខ្ញុំអាចប្រមូលព័ត៌មានអំពីបញ្ញត្តិវិទ្យាសាស្ត្របានត្រឹមត្រូវ					
៥	ខ្ញុំប្រាកដថាខ្ញុំអាចធ្វើពិសោធន៍វិទ្យាសាស្ត្រនៅក្នុងមន្ទីរពិសោធន៍បានត្រឹមត្រូវ					

ខ. បច្ចេកវិទ្យា

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំអាចទាញយករូបភាព ឬ វីឌេអូពីក្នុងអ៊ិនធើណេតបាន					
២	ខ្ញុំអាចប្រើប្រាស់ឧបករណ៍ប្រចាំថ្ងៃទាក់ទងនឹងបច្ចេកវិទ្យា ដូចជាឆ្នាំងដាំបាយអគ្គីសនី ម៉ាស៊ីនទឹកក្រឡុក ម៉ាស៊ីនកម្តៅនំប៉ុង..... បានយ៉ាងល្អ					

៣	ខ្ញុំអាចប្រើប្រាស់កុំព្យូទ័របានយ៉ាងស្ទាត់ជំនាញ					
៤	ខ្ញុំអាចប្រើប្រាស់ឧបករណ៍ឌីជីថលដូចជា smartphone, iPad, tablet...បានយ៉ាងល្អ					
៥	ខ្ញុំអាចប្រើប្រាស់បណ្ដាញសង្គមដូចជា Facebook, Instagram, Twitter... បានយ៉ាងល្អ					

គ. វិស្វកម្ម

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំប្រាកដថាខ្ញុំអាចសាងសង់មនុស្សយន្តពីLegoបាន					
២	ខ្ញុំអាចប្រើប្រដាប់ផ្សារដែកឬប្រដាប់រំលាយសំណរបានត្រឹមត្រូវ					
៣	ខ្ញុំអាចដំឡើងគ្រឿងសង្ហារឹមបាន					
៤	ខ្ញុំអាចតខ្សែភ្លើងបាន *(ស្មៀគីអគ្គីសនី)*					
៥	ខ្ញុំអាចជួសជុលប្រដាប់ប្រដារក្មេងលេងបាន					

ឃ. គណិតវិទ្យា

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំអាចទទួលបានពិន្ទុល្អសំរាប់មុខវិជ្ជាគណិតវិទ្យា					
២	ខ្ញុំមានជំនឿជាក់ថាខ្ញុំអាចកត់ត្រាទិន្នន័យបានត្រឹមត្រូវ					
៣	ខ្ញុំអាចគូសគំនូរតាងតាមទិន្នន័យដែលផ្តល់អោយ					
៤	ខ្ញុំមានសមត្ថភាពក្នុងការប្រើម៉ាស៊ីនគិតលេខតាមបែបវិទ្យាសាស្រ្ត					
៥	ខ្ញុំអាចដោះស្រាយលំហាត់គណិតវិទ្យាបានយ៉ាងត្រឹមត្រូវ					

4. <u>ចំណាប់អារម្មណ៍លើអាជីពទាក់ទងនឹងស្ទែម (STME)</u>

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

ក. វិទ្យាសាស្រ្ត

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំមានគម្រោងប្រើប្រាស់វិទ្យាសាស្រ្តសម្រាប់អាជីពរបស់ខ្ញុំនាពេលអនាគត					

២	ប្រសិនបើខ្ញុំរៀនមុខវិជ្ជាវិទ្យាសាស្ត្របានល្អ វានឹងជួយខ្ញុំសំរាប់អាជីពនាពេលអនាគត					
៣	ខ្ញុំចាប់អារម្មណ៍អាជីពដែលប្រើប្រាស់វិទ្យាសាស្ត្រ					
៤	ខ្ញុំមានអារម្មណ៍កក់ក្ដៅនៅពេលនិយាយជាមួយអ្នកដែលមានអាជីពទាក់ទងនឹងវិទ្យាសាស្ត្រ					
៥	ខ្ញុំមានសមាជិកគ្រួសាររបស់ខ្ញុំដែលប្រើវិទ្យាសាស្ត្រក្នុងអាជីពរបស់គាត់					

ខ. បច្ចេកវិទ្យា

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំមានគម្រោងប្រើប្រាស់បច្ចេកវិទ្យាសំរាប់អាជីពនាពេលអនាគតរបស់ខ្ញុំ					
២	ប្រសិនបើខ្ញុំរៀនអំពីបច្ចេកវិទ្យាបានច្រើន ខ្ញុំនឹងអាចមានជម្រើសច្រើនសម្រាប់អាជីពអនាគត					
៣	ខ្ញុំចាប់អារម្មណ៍នឹងអាជីពដែលប្រើបច្ចេកវិទ្យា					
៤	ខ្ញុំមានអារម្មណ៍កក់ក្ដៅនៅពេលនិយាយជាមួយអ្នកដែលមានអាជីពទាក់ទងនឹងបច្ចេកវិទ្យា					
៥	ខ្ញុំមានសមាជិកគ្រួសាររបស់ខ្ញុំដែលប្រើបច្ចេកវិទ្យាក្នុងអាជីពរបស់គាត់					

គ. វិស្វកម្ម

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំមានគម្រោងប្រើប្រាស់វិស្វកម្មសំរាប់អាជីពនាពេលអនាគតរបស់ខ្ញុំ					
២	ប្រសិនបើខ្ញុំរៀនអំពីវិស្វកម្មបានច្រើន ខ្ញុំនឹងអាចមានជម្រើសច្រើនសម្រាប់អាជីពអនាគត					
៣	ខ្ញុំចាប់អារម្មណ៍នឹងអាជីពដែលប្រើវិស្វកម្ម					
៤	ខ្ញុំមានអារម្មណ៍កក់ក្ដៅនៅពេលនិយាយជាមួយអ្នកដែលមានអាជីពទាក់ទងនឹងវិស្វកម្ម					
៥	ខ្ញុំមានសមាជិកគ្រួសាររបស់ខ្ញុំដែលប្រើវិស្វកម្មក្នុងអាជីពរបស់គាត់					

ឃ. គណិតវិទ្យា

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំមានគម្រោងប្រើប្រាស់គណិតវិទ្យាសំរាប់អាជីពនាពេលអនាគតរបស់ខ្ញុំ					
២	ប្រសិនបើខ្ញុំរៀនមុខវិជ្ជាគណិតវិទ្យាបានល្អ វានឹងជួយខ្ញុំសំរាប់អាជីពនាពេលអនាគត					
៣	ខ្ញុំចាប់អារម្មណ៍អាជីពដែលប្រើប្រាស់គណិតវិទ្យា					

៤	ខ្ញុំមានអារម្មណ៍កក់ក្ដៅនៅពេលនិយាយជាមួយអ្នកដែលមានអាជីពទាក់ទងនឹងគណិតវិទ្យា					
៥	ខ្ញុំមានសមាជិកគ្រួសាររបស់ខ្ញុំដែលប្រើគណិតវិទ្យាក្នុងអាជីពរបស់គាត់					

IV. សាលារៀន

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ប្រយោគនីមួយៗ

1. សកម្មភាពក្រៅថ្នាក់

ល.រ	*ប្រយោគ*	*មិនដែលចូលរួម*	*ម្ដងម្កាល*	*ញឹកញាប់*	*ញឹកញាប់ខ្លាំង*	*តែងតែចូលរួម*
១	ខ្ញុំចូលរួមក្លឹបផ្សេងៗនៅសាលាទាក់ទងនឹងស្ទែម (STEM)					
២	ខ្ញុំចូលរួមមហោស្រពពិពណ៌វិទ្យាសាស្ត្រ					
៣	ខ្ញុំទៅមើលមហោស្រពពិពណ៌វិទ្យាសាស្ត្រ					
៤	ខ្ញុំចូលរួមការប្រកួតផ្សេងៗទាក់ទងនឹងស្ទែម					
៥	ខ្ញុំទៅទស្សនាមជ្ឈមណ្ឌលស្រាវជ្រាវនៅក្នុងរោងចក្រ ឬសាកលវិទ្យាល័យ					

2. ពិព័ណ៌ការងារជាតិ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំចូលរួមពិព័ណ៌ការងារជាតិ					

២	ខ្ញុំទទួលបានពត៏មានជាច្រើនអំពីការងារក្នុងពិព័ណ៌ការងារជាតិ					
៣	ខ្ញុំជ្រើសរើសការងារដោយសារព័ត៌មានទទួលបានពីពិព័ណ៌ការងារជាតិ					
៤	ពិព័ណ៌ការងារជាតិមានឥទ្ធិពលលើការសម្រេចចិត្តជ្រើសរើសអាជីពរបស់ខ្ញុំ					
៥	ពិព័ណ៌ការងារជាតិមានអត្ថប្រយោជន៍ខ្លាំងណាស់					

3. បរិស្ថានការអប់រំ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	លោកគ្រូ/អ្នកគ្រូលើកទឹកចិត្តខ្ញុំយ៉ាងខ្លាំងអោយពិចារណានូវជម្រើសអាជីពជាច្រើនរួមទាំងអាជីពមិនមែនសំរាប់ស្ត្រី					
២	កង្វះសម្ភារៈមន្ទីរពិសោធន៍នៅក្នុងសាលាធ្វើអោយខ្ញុំបោះបង់ការរៀនមុខវិជ្ជាវិទ្យាសាស្ត្រ					
៣	ជាទូទៅលោកគ្រូ/អ្នកគ្រូយកចិត្តទុកដាក់ដូចគ្នាចំពោះសិស្សប្រុស និងសិស្សស្រី					
៤	លោកគ្រូ/អ្នកគ្រូសង្ឃឹមថាសិស្សប្រុស និងសិស្សស្រី នឹងទទួលបានលទ្ធផលសិក្សាដូចគ្នា					

៥	លោកគ្រូ/អ្នកគ្រូលើកឧទាហរណ៍ក្នុងសៀវភៅសិក្សា និងសំភារៈបង្រៀនផ្សេងៗដែលមានលក្ខណៈលំអៀងរវាងសិស្សប្រុស និងសិស្សស្រី					

4. *ការរៀនអនឡាញ*

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំរៀនបានល្អលើមុខវិជ្ជាវិទ្យាសាស្រ្ត និងគណិតវិទ្យាតាម រយៈការរៀនអនឡាញ					
២	ខ្ញុំផ្លាស់ប្តូរការជ្រើសរើសអាជីពមិនទាក់ទងនឹងស្ទែមមកអាជីពទាក់ទងនឹងស្ទែម ដោយសារការរៀនអនឡាញ					
៣	ខ្ញុំផ្លាស់ប្តូរការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែមមកអាជីពមិនទាក់ទងនឹងស្ទែម ដោយសារការរៀនអនឡាញ					
៤	ខ្ញុំមានការលំបាកក្នុងការរៀនអនឡាញសំរាប់មុខវិជ្ជាវិទ្យាសាស្រ្ត និងគណិតវិទ្យា					
៥	ការរៀនអនឡាញមានឥទ្ធិពលលើការជ្រើសរើសអាជីពរបស់ខ្ញុំ					

តើការរៀនអនឡាញមានឥទ្ធិពលលើការជ្រើសរើសអាជីពរបស់ប្អូនដែរ ឬ ទេ? បើមានសូមពន្យល់។

V. កត្តាបរិស្ថាន និងសង្គម

សូមគូសសញ្ញា √ ក្នុងប្រអប់ចម្លើយដែលត្រឹមត្រូវបំផុតចំពោះប្អូនសម្រាប់ល្បះនីមួយៗ

1. តួនាទីយេនឌ័រ

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	អាជីពខ្លះសក្តិសមនឹងមនុស្សប្រុស តែអាជីពខ្លះសក្តិសមនឹងមនុស្សស្រី					
២	សិស្សប្រុសមានមហិច្ឆតាការងារខ្ពស់ជាងសិស្សស្រី					
៣	មនុស្សប្រុស និងមនុស្សស្រីត្រូវបានកំណត់ដោយកត្តាសង្គមក្នុងការជ្រើសរើសអាជីព ហើយស្រីរងផលប៉ះពាល់ច្រើនជាង					
៤	តួនាទីរបស់ស្រីគឺមើលថែទាំកូន និងធ្វើកិច្ចការផ្ទះ ចំណែកប្រុសៗមានតួនាទីចេញក្រៅធ្វើការងាររកប្រាក់					
៥	មនុស្សប្រុសអាចប្រើប្រាស់កុំព្យូទ័រដើម្បីដោះស្រាយបញ្ហាបានល្អជាងមនុស្សស្រី					

2. ជនគំរូ និងអ្នកប្រឹក្សា

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ជនគំរូប្រុសមានឥទ្ធិពលលើអាជីពដែលខ្ញុំចង់ធ្វើ					
២	ជនគំរូស្រីមានឥទ្ធិពលលើអាជីពដែលខ្ញុំចង់ធ្វើ					

៣	ខ្ញុំឱ្យតម្លៃការណែនាំទាក់ទងនឹងអាជីពពីមិត្តដែលមានភេទដូចខ្ញុំ					
៤	ខ្ញុំមានជនគំរូជាស្ត្រីម្នាក់សម្រាប់អាជីពដែលខ្ញុំស្រលាញ់					
៥	ខ្ញុំមានអ្នកប្រឹក្សាក្នុងការជ្រើសរើសអាជីពជាស្រី					

3. ការប្រឹក្សា និងផ្តល់យោបល់

ល.រ	*ប្រយោគ*	*មិនយល់ស្របខ្លាំង*	*មិនយល់ស្រប*	*ធម្មតា*	*យល់ស្រប*	*យល់ស្របខ្លាំង*
១	ខ្ញុំទទួលបានការណែនាំពីលោកគ្រូ/អ្នកគ្រូក្នុងការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					
២	ខ្ញុំទទួលបានការណែនាំពីសិស្សច្បងក្នុងការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					
៣	ខ្ញុំទទួលបានការណែនាំពីមិត្តរួមថ្នាក់ក្នុងការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					
៤	ការណែនាំរបស់អ្នកដ៏ទៃមានឥទ្ធិពលលើការជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)					
៥	ខ្ញុំជ្រើសរើសអាជីពទាក់ទងនឹងស្ទែម(STEM)ដោយខ្លួនឯង					

Appendix 7: Curriculum vitae

I. Personal Information:

Latin Name: Monyrath SAR

Place of Birth: Kandal Province, Kingdom of Cambodia

Email: sarmonyrath@yahoo.com/monyraths@gmail.com

II. Academic Qualifications:

2019-present:	Pursuing doctoral degree in Education Development at Graduate School for International Development and Cooperation, Hiroshima University
2012 – 2014:	Master of Education at Graduate School for International Development and Cooperation, Hiroshima University
2003 – 2012:	Bachelor of English literature for Business, Pannasatra University of Cambodia
2006– 2007:	Higher Education Teaching Course, National Institute of Education
2002 – 2006:	Bachelor of Biology, Royal University of Phnom Penh
1994 – 2001:	Chinese General Education, Xin Hau School

III. Published Peer-Reviewed Journal Articles:

- Sar, M. (2021). Factor Affecting Female Students' Choice of Science, Technology, Engineering, and Mathematics (STEM) Career Choice: Literature Review. *Unnes Science Education Journal*, 10(2), 69–78.
- Sar, M. (2021). The Development of Questionnaire to Measure Science, Technology, Engineering and Mathematics (STEM) Career Choice: Evidence from Cambodia. *Cambodia Education Review (CER)*, 4(2), 21-46.

IV. Academic Conference Presentations:

- Sar, M. (2019). Development of Science Process Skills from Inquiry-Based Approaches in Learning Biology at Upper Secondary Level in Cambodia: A Case Study in Hun Sen Chomkar Doung High School. Presented at 58th OSEAL forum (on 09th November 2019) at Hiroshima City, Japan.
- Sar, M. (2021). Factor Affecting Female Students' Choice of Science, Technology, Engineering, and Mathematics (STEM) Career Choice: A Literature Review. Presented at 71st National Conference of SJST (Conducted online 19th-20th September 2021), Hiroshima University, Japan.

V. Academic Award:

December 13, 2021: Hiroshima University Excellent Student Award