Structural Equation Modelling of Students' Strand Preference in Science, Technology, Engineering and Mathematics

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ABSTRACT

This study examines the factors influencing Grade 11 STEM students' strand preference in senior high school, focusing on job opportunities, family and peer influence, individual interests, and entry qualifications, using Structural Equation Modelling (SEM) to analyze their relationships. This study employing descriptive – correlational research design determined the Structural Equation Model (SEM), which analyzed the relationships among students' job opportunities (JO), family influence (FI), peer influence (PI), individual interests (II), and students' preference for the STEM strand, based on entry qualifications (EQ) of Grade 11 STEM students of Banga National High School and Libertad National High School, School Year 2024 – 2025. A total of 176 students were the respondents of the study. The study employing a complete enumeration sampling technique. The study revealed that job opportunities significantly influence students' preference for the STEM strand, yet job salary, employability, and stability require greater intervention to guide students in their decision-making. Similarly, family and peer influence moderately impact students' strand choices, with parents' final decisions and career backgrounds playing a crucial role. Peer groups also contribute by sharing opinions and experiences, but their influence is primarily on shaping interest rather than entry qualifications. Regarding entry qualifications, most students met the required general average in Science and Mathematics, but many struggled with the entrance examination. The findings also indicate that family influence negatively affects entry qualifications but fosters individual interest, while job opportunities and peer influence contribute to students' interest but do not directly impact entry qualifications. Additionally, individual interest does not mediate entry qualifications, suggesting that other factors may play a more significant role in determining students' readiness for STEM.

Keywords: Strand preference, job opportunities, family influence, peer influence and individual interests

INTRODUCTION

Choosing a career in Science, Technology, Engineering, and Mathematics (STEM) is a pivotal decision that influences students' academic and professional paths. Many students face challenges in selecting the right academic strand that aligns with their interests, skills, and future career opportunities. While some are drawn to STEM due to its promising job prospects, others may be influenced by external factors such as family expectations, peer pressure, or societal trends. Despite the increasing emphasis on STEM education, there remains a disparity between students' interest in STEM and their actual qualifications, raising concerns about their readiness and long-term success in the field.

The global demand for STEM professionals continues to grow, fueled by rapid technological advancements and innovation. However, many countries face challenges in producing enough STEM graduates to meet industry demands. UNESCO (2023) reports a significant gap in STEM education, particularly among underrepresented groups, which hinders workforce diversity and innovation. Likewise, the World Economic Forum (2020) highlights that while STEM careers are among the most sought-after, many students lack the necessary skills and motivation to pursue them. Additionally, Marginson et al. (2019) emphasize that despite STEM education being a global priority, disparities in access to quality instruction and resources contribute to uneven student participation and success rates.

In the Philippines, the topic of senior high school enrollment often highlights the Science, Technology, Engineering, and Mathematics (STEM) strand. Data from the Department of Education (DepEd) shows that 23.24% of the 2.8 million senior high school students enrolled in the 2022–2023 academic year chose the STEM strand (Sison, 2022). Acido and Caballes (2023) examined Filipino students' performance in the Programme for International Student Assessment (PISA), conducted by the OECD. Their research revealed that Filipino students consistently ranked among the lowest globally in mathematics, reading, and science, with little improvement between the 2018 and 2022 assessments. To address this, proposals such as extending the Department of Science and Technology – Science Education Institute scholarships to senior high school students have been introduced to boost STEM participation.

Locally, schools encounter difficulties in steering students toward the STEM strand and ensuring they meet the required qualifications. Although many students show a keen interest in STEM fields, they frequently face challenges with problem-solving and test-taking abilities. For example, Ferrer and Cruz (2017) explored the connection between STEM students' National Career Assessment Examination (NCAE) scores and their academic performance, uncovering issues with standardized assessments. Likewise, Sauro (2024) identified a strong link between learning strategies, attitudes, and physics problem-solving skills among Grade 12 STEM students in Davao City, emphasizing that critical STEM-related skills remain a hurdle despite students' enthusiasm. Furthermore, Simpal et al. (2024) emphasized the impact of environmental factors, personality, job opportunities, and peer influence on students' strand choices, underscoring the need for stronger guidance programs in schools.

This study addresses a research gap, as previous investigations have primarily focused on individual predictors of STEM strand preference rather than the combined influence of factors such as family background, peer pressure, career prospects, and personal interest. By employing Structural Equation Modeling (SEM), this study seeks to offer an in-depth analysis of the interactions among these variables.

As STEM education continues to play a crucial role in national and global development, it is essential to examine the factors that shape students' strand preferences and readiness. This research investigates the determinants influencing strand selection among Grade 11 STEM students at Banga National High School and Libertad National High School, where choosing a senior high school strand presents challenges. By integrating insights from existing literature, this study aims to examine trends, factors, and obstacles affecting students' decision-making processes. The results support the creation of tailored interventions and career counseling initiatives, empowering students to make well-informed choices that align with their abilities, passions, and goals. Furthermore, the application of SEM in this study promotes its broader use in educational research, encouraging further exploration by scholars and stakeholders.

Theoretical Framework

The theoretical framework outlines the foundational theory that serves as the cornerstone or springboard of the research (Macaso & Dagohoy, 2022). Hence, study was grounded in the theories and concepts developed by recognized scholars and experts in the field.

The foundation of this study was anchored by Al-Salem's (2017) Choosing Course Factor Theory, which identifies three major categories of factors—course-related, social, and individual—that significantly influence students' choices. The study employed SEM to develop a framework of indicators for students' strand preferences in senior high school. This approach examines the interactions among the constructs within the study's framework. SEM was used to interpret the results regarding the direct and indirect influences of students' personal interests, family guidance, peer influence, and job opportunities on their strand preferences in senior high school. These processes were essential for understanding how students make decisions about the strands offered in senior high school. Al-Salem's Choosing Course Factor Theory categorizes the key influences into course-related (job opportunities), social (peer and family influence), and individual (personal interest) factors.

Moreover, this study was rooted in Albert Bandura's Social Cognitive Theory, introduced in 1986, which emphasizes that learning takes place through observation. It supports the role of peer and family influence through observational learning and environmental interaction. It underscores the role of environmental factors, personal characteristics, and cognitive processes in shaping behavior (Kauffman et al., 2023).

Additionally, it was guided by Jean Piaget's Constructivist Theory, which emphasizes the active, social, and contextual nature of learning, aiming to help learners develop deep and meaningful understandings of concepts (Chand, 2024). The Choice Theory by William Glasser in 1998, which was cited in Charles (2008), the Choice Theory outlines the foundational principles of the university, which explain that everyone is free to express their creativity, that everyone is naturally interested, and that the learner initiates and pursues the most effective and knowledgeable learning. According to this view, the development of their knowledge, creativity, and abilities would help them settle down and will offer them a clue as to what they need for their future careers. It also asserted that freedom is crucial to the event of their own responsibility. The choice theory is essential to this study for the reason that it explains the developments of one's skills, ingenuity, and knowledge, which gives them a clue as to the career paths they should follow. It will also help them understand their tracks and ensure that they take it seriously when selecting their specialized tracks. Constructivist Theory and Choice Theory highlight the importance of personal interest, emphasizing active learning, autonomy, and self-motivation in decision-making.

Howard Gardner's 1993 Theory of Multiple Intelligences also underpins this investigation as it explains how individual strengths shape interests and preferences. The theory posits that each individual learns uniquely and employs various intelligences in their daily lives. It implies that a universal approach may not be effective to learning may cause some children to lag behind. Therefore, teachers use the multiple intelligences approach in the classroom, which benefits both students and educators.

Borch (1967) formulated risk theory, which explores how potential outcomes influence the trajectory and results of actions. It also explains how students assess job opportunities by weighing potential rewards and risks. When selecting a course, students have various expectations of returns, but they also acknowledge the possibility that those expectations may not be fulfilled. Together, these theories offer a comprehensive understanding of the variables used in the SEM model.

Figure 1 presents how the Students' Strand Preference in STEM (SSPS) was influenced by the latent variables Student's Individual interests, family influence, peer influence and job opportunities. It also illustrates how the Personal Interest as the mediator in the framework of SEM was influenced by the latent variable's family influence and peer influence in relation to student's preference on STEM strand. Similarity, it illustrates how the students' preference on STEM strand affects the formulation of Structural Equation Model (SEM) to create early intervention among students. The single arrowhead connecting the latent variables (personal interests, family influence, peer influence and job opportunities) demonstrates how the dependent variable responds to the stimulus given by the independent variable. Thus, job opportunities aspects of the students focus on the factors that affects students' choice in selecting a STEM strand in thru career path considerations, strand alignment to equivalent job and expected job opportunities. The statements in students' family influence was focus on the influences driven by the family members that could affects the decision of a student. Indicators in students' peer influence covered on factors brought by the student's peers' inspiration, encouragement and advice that could contribute to the students' choice in selecting a STEM. Also, statements in students' Individual interests in students' choice in selecting a STEM conferred on its desire, aptitudes, capabilities, habits, skills and interest that was contribute a direct relationship to students' preferences to STEM strand offered in senior high school. Finally, the students' preferences focused on the entry qualifications to STEM strand which leads to creating and testing the structural equation modeling.

The indicators used in the study were developed through a mix of adaptation and original construction. Some were adapted from existing validated studies, especially for variables like peer influence, family influence, and job opportunities, with slight modifications to fit the context of STEM strand selection. Others, particularly those related to personal interest and student preference, were newly created to address specific aspects of strand choice. Each set of indicators was designed to reflect the key constructs in the SEM framework, ensuring they accurately captured factors such as career considerations, family and peer encouragement, individual skills and interests, and entry requirements for the STEM strand.

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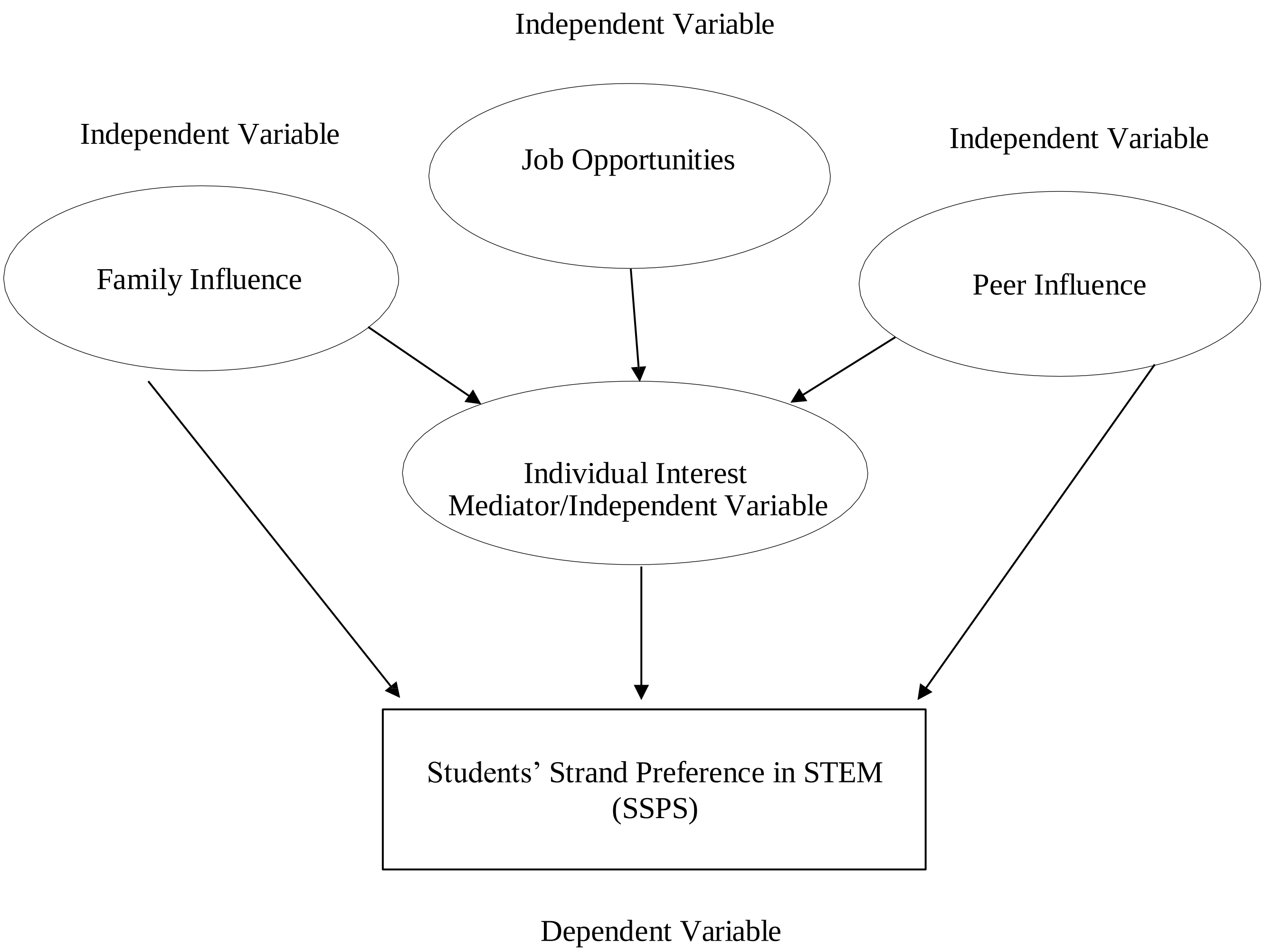

Figure 1. Conceptual Paradigm of the Study

Statement of the Problem

Generally, the study aimed to formulate Structural Equation Modeling (SEM) among Students' Job Opportunities to Strand Preference (SJOSP), Students' Family Influence to Strand Preference (SFISP), Students' Individual Interest to Strand Preference (SIISP), Students' Peer Influence to Strand Preference (SPISP), and Students' Strand Preference in STEM (SSPS) of grade 11STEM students of Banga National High School and Libertad National High School.

Specifically, the researcher sought to address the following questions:

1. What is the level of students' strand preference on STEM in terms of:

   1.1 Job Opportunities;
   1.2 Family Influence;
   1.3 Peer Influence; and,
   1.4 Individual Interest?

2. What is the entry qualifications to STEM strand in terms of:

   2.1 General Average in Mathematics and Science;
   2.2 Entrance Exam; and,
   2.3 Entrance Interview?

3. Is there significant relationship among students' job opportunities, family influence, peer influence and

individual interest to strand preference in STEM, and entry qualifications to STEM strand offered?

4. What structural equation modeling may be formulated in the predictors of students' preference in STEM strand offered?

Hypothesis of the Study

The hypothesis of study was tested 5% significance level to determine the relationship among latent variables of student's preference to strand offered of grade 11 STEM students of Banga National High School in the academic year 2024-2025.

H_a. There is a significant relationship among students' job opportunities, family influence, peer influence and individual interest to strand preference in STEM.

METHODOLOGY

Research Design

The study employed a descriptive-correlational approach. The descriptive design was used to observe, document, and characterize a phenomenon in its natural setting without applying any control or manipulation (Shinija, 2024).

Similarly, to analyze the relationship between the predictors of students' preference for the STEM strand and the factors influencing their decision to choose it, a correlational design was utilized. This non-experimental design examines the relationships between two or more variables and is commonly used to explore associations within a single group (Devi et al., 2023).

Respondents

The study involved Grade 11 STEM students from Banga National High School (BNHS) and Libertad National High School (LINHS), who were enrolled during the second semester of the 2024-2025 academic year. They were chosen for this study because they had already experienced the process of strand selection which includes several career guidance seminars and entry qualification screening.

Data Gathering Instruments

The structural equation modeling of students' strand preference in STEM was conducted during the third quarter of the 2024-2025 school year among Grade 11 STEM students at Banga National High School and Libertad National High School.

The study used a researcher-made 23-item survey questionnaire to collect data on factors influencing students' preference for the STEM strand. The questionnaire covered five constructs: individual interests, peer influence, family influence, job opportunities, and students' strand preference. Each latent variable—peer influence, family influence, job opportunities, and individual interests—was measured using multiple indicators focusing on aspects like abilities, encouragement, support, employability, and career alignment. The questionnaire was validated by three experts in Mathematics education and school leadership. The first part assessed students' distribution of preference for the STEM strand, while the second part examined the extent of influence from the four latent variables.

Data Gathering Procedures

The researcher designed and validated a survey questionnaire with input from three expert evaluators. After validation, a pilot test was conducted at Rizal 3 National High School to assess the questionnaire's reliability and the feasibility of the study design. The pilot test helped improve the instrument's validity and efficiency. Following this, the researcher sought and received approval from the Dean of the Graduate School and the principals of Banga and Libertad National High Schools to conduct the main study with Grade 11 STEM students. The survey was administered with clear instructions, ensuring participants' understanding and confidentiality. After data collection, the researcher, with help from a research adviser and a statistician, organized, tabulated, and analyzed the data using SPSS and AMOS to ensure accurate and reliable results.

Statistical Treatment

The study employed descriptive statistics, Pearson's r correlation, and Structural Equation Modeling (SEM) using SPSS and AMOS software. Pearson's r measured the relationship between strand preferences and influencing factors, while SEM tested the overall model. A 0.05 significance level was used for all statistical tests.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Research Ethics Review Committee. Consent forms were given to parents, and only students with signed consent participated. To ensure confidentiality and anonymity, participants were assigned codes instead of names, and all data were securely stored. No identifying information was used in the analysis or reporting. The study followed the Data Privacy Act of 2012, and participants were informed of their right to withdraw at any time. No harm or distress occurred during the study.

RESULTS AND DISCUSSION

This chapter provides an analysis and interpretation of relevant data to determine the Structural Equation Model (SEM), which examines the relationships among students' job opportunities (JO), family influence (FI), peer influence (PI), individual interests (II), and students' preference for the STEM strand, based on entry qualifications (EQ).

Table 1. The Level of Strand Preference in Terms of Job Opportunities.

Indicators	Mean	SD	Interpretation
1. I will choose a strand based on its job demand that suits me.	4.43	0.72	Very High Influence
2. I will choose a strand based on its salary expectation.	4.17	0.85	High Influence
3. I will prefer a strand based on its employability and stability.	4.44	0.66	Very High Influence
4. I will choose a strand based on its future environment.	4.59	2.26	Very High Influence
5. I will choose a strand based on its availability on the news and job market.	3.80	0.89	High Influence
Section Mean	4.29	0.61	Very High Influence

Table 1 reveals that among job opportunity factors, students' future work environment had the highest influence on their STEM strand preference, with a mean of 4.59 and a standard deviation of 2.26, interpreted as "Very High Influence." This indicates that students highly value the kind of work environment they expect in the future when choosing their strand. Additionally, job employability and stability ranked second with a mean of 4.44 and standard deviation of 0.66, also rated as "Very High Influence," showing that students strongly consider job security and employment potential when selecting the STEM strand.

Students often choose courses that align with their career aspirations, such as selecting the STEM strand for careers in engineering or medicine. This choice helps tailor their education to the specific knowledge and skills required in these fields. Students are aware of the competencies the STEM strand offers, preparing them for future coursework and professional opportunities (Bundang et al., 2024). It also supports the stduy of Xue & Larson (2015) showing that students are more motivated to pursue STEM education when they recognize the high demand for careers in fields like engineering, information technology, and healthcare.

However, the results show that job availability in the news and the job market had the lowest influence on students' STEM strand preference, with a mean of 3.80 and a standard deviation of 0.89, interpreted as "High Influence." The second lowest was salary expectation, with a mean of 4.17 and standard deviation of 0.85, also rated as "High Influence." Despite being lower than other factors, these results indicate that students still consider job salary, employability, and stability when choosing the STEM strand. This highlights the need for better exposure and understanding of job market trends and employability among students.

When students perceive strong career prospects in STEM-related industries, they are more likely to choose the STEM strand. The prospect of good employment opportunities and high salaries serves as a significant motivator, leading students to align their education with these fields (Rafanan et al., 2020). The potential for financial stability and professional growth in STEM careers plays a major role in influencing their strand preferences.

The results show that job availability in the news and the job market had the lowest influence on students' STEM strand preference, with a mean of 3.80 and a standard deviation of 0.89, interpreted as "High Influence." The second lowest was salary expectation, with a mean of 4.17 and standard deviation of 0.85, also rated as "High Influence." Despite being lower than other factors, these results indicate that students still consider job salary, employability, and stability when choosing the STEM strand. This highlights the need for better exposure and understanding of job market trends and employability among students.

Table 2. The Level of Strand Preference in Terms of Family Influence.

Indicators	Mean	SD	Interpretation
1. I seek my parents' advice when deciding on something.	3.94	1.00	High Influence
2. My final senior high strand decision depends on my parents.	2.36	1.03	Low Influence
3. My family support me in anything I do or choose.	4.48	0.80	Very High Influence
4. I consider my parents' career in choosing my senior high school strand.	2.88	1.18	Neutral Influence
5. I choose this strand based on my family's perception of my future career.	3.19	1.21	Neutral Influence
Section Mean	3.37	0.63	Neutral Influence

Table 2 indicates that family support for every decision had the highest influence on students' STEM strand preference, with a mean of 4.48 and a standard deviation of 0.80, interpreted as "Very High Influence." This suggests that students strongly value their family's support in their decision-making. The second highest influence was students seeking their parents' advice when choosing a strand, with a mean of 3.94 and a standard deviation of 1.00, interpreted as "High Influence." This shows that students consider parental guidance important in their strand selection process.

A study examining the influence of personality, environment, and parental involvement on Grade 10 students' strand selection highlighted the important role of family support in decision-making. It found that parental involvement, through expectations and guidance, significantly shapes students' academic choices (Simpal et al., 2024). Additionally, research by Wang & Degol (2017) showed that students are more likely to pursue STEM careers when their parents actively engage in discussions about career options and provide academic support.

In contrast, students' final senior high strand decision depending on their parents results to lowest mean 2.36, standard deviation of 1.03 and interpreted as "Low Influence". Moreover, second lowest mean of 2.88, standard deviation of 1.18 and interpreted as "Neutral Influence" that student considers parents' career in selecting a STEM strand. The results emphasized that the Grade 11 STEM students neither consider nor disregard their parent's decision and career in selecting a STEM strand. This implies that in strand preference in family influence, there is a need for urging the students to listen to their parents' decision and consider their career profession.

Parents play a crucial role in shaping their children's educational choices, especially for students interested in science and technology, as they are often guided toward the STEM strand through parental encouragement. Additionally, a family's financial situation significantly influences career decisions, as economic stability impacts access to educational and training opportunities (Kilag et al., 2023). Research by Gudoy et al. (2024) at the University of Saint Louis-Tuguegarao found that students consider their parents' occupations and job satisfaction when making career decisions. The study also emphasized that parental involvement, such as discussing career paths and motivating academic efforts, is key in guiding students toward specific educational tracks.

The level of strand preference in terms of family influence was interpreted as "Neutral Influence", with a section mean of 3.37 and standard deviation of 0.63, indicating that the students neither agree or disagree that family influence affects the strand preference of students. Thus, Students' parents' final decision and considers parents' career in selecting a STEM strand needs a high interference. Also, the results highlighted that family support influences the students' preference to strand offered.

Table 3. The Level of Strand Preference in Terms of Peer Influence.

Indicators	Mean	SD	Interpretation
1. My peers motivate me to pursue my goals, including selecting a strand.	3.88	1.02	High Influence
2. I go by the trend in class/campus in choosing the strand.	2.39	1.10	Low Influence
3. My friends will acknowledge me if I choose the strand same with them.	2.48	1.17	Low Influence
4.. I and my peer group share thoughts and opinion in choosing strand.	3.81	1.02	High Influence
5. My friend's decision is my decision as well.	1.77	0.97	Very Low Influence
Section Mean	2.87	0.71	Neutral Influence

Table 3 shows the student's strand preference in terms of peer influence were easily viewed based on student's peers' encouragement to do things to achieve goals like choosing a strand with the highest mean of 3.88, standard deviation of 1.02, and interpreted as "High Influence". This result reveals that students agree that peers' encouragement to pursue their goals plays a vital role in influencing their strand preference in STEM. Also, the result shows that students' peer group share thoughts and opinion in choosing strand, which results to second highest mean of 3.81, standard deviation of 1.02, and interpreted as "High Influence". This implies that students agree that sharing thoughts and opinion from peers influences STEM strand selection.

A study by Madriaga et al. (2022) found that students' decisions to choose the STEM strand are strongly influenced by personal factors like family, peer motivation, and career aspirations. Peer encouragement, in particular, was identified as a key factor in pursuing STEM education. Research on high school seniors also shows that peers significantly shape career decisions, with many students acknowledging their friends' influence in selecting the STEM strand. Peer influence remains a crucial factor in strand selection, as students often consider their friends' opinions when making academic choices, highlighting the importance of peer discussions in guiding educational decisions (Rafanan et al., 2020).

On the other hand, students' friend's decision really matters to lowest mean 1.77, standard deviation of 0.97 and interpreted as "Very Low Influence". Moreover, second lowest mean of 2.39, standard deviation of 1.10 and interpreted as "Low Influence" that student go by the trend in class/campus in choosing the strand. The results emphasized that the Grade 11 STEM students neither consider nor disregard their friend's decision and school trend in choosing a strand in Senior High School. This implies that the students should sometimes go with their peers and interact with them to have an idea in selecting a strand in Senior High School.

Exposure to high-achieving peers, especially those excelling in mathematics, can motivate students to pursue

STEM programs. Research by Mouganie & Wang (2019) found that female students who excel in arithmetic positively influence their female peers, encouraging them to consider STEM careers. Additionally, studies on high school seniors show that peers significantly impact career decisions, with many students attributing their choice of the STEM strand to the encouragement and influence of their friends (Raabe et al., 2019).

The level of strand preference in terms of peer influence was interpreted as "Neutral Influence", with a section mean of 2.87 and standard deviation of 0.71, indicating that the students neither consider nor disregard that peer influence affects the strand preference of students. Thus, in order to get ideas for choosing a strand in senior high school, students should occasionally go with their peers and engage with them. Also, the results highlighted that students' peer group share thoughts and opinion in choosing strand in Senior High School.

Table 4. The Level of Strand Preference in Terms of Individual Interest.

Indicators	Mean	SD	Interpretation
1. I choose this strand because it has subjects where I could get good academic grades.	3.58	0.93	High Influence
2. I consider my aptitudes, skills and capabilities in choosing a strand.	4.05	0.78	High Influence
3. I choose this strand because the subjects are interesting.	3.74	0.96	High Influence
4. My personality and habits are suited to the strand I choose.	3.44	0.98	High Influence
5. I choose this strand because it associates with my dream career.	4.48	0.82	Very High Influence
Section Mean	3.86	0.61	High Influence

Table 4 shows that students' strand preference, in terms of individual interest, is strongly influenced by their dream career, with the highest mean of 4.48 and a standard deviation of 0.82, interpreted as "Very High Influence." This suggests that students strongly consider their desired career when choosing a STEM strand. The second highest influence was students considering their aptitudes, skills, and capabilities in strand selection, with a mean of 4.05 and a standard deviation of 0.78, interpreted as "High Influence."

The connection between educational choices and career aspirations is clear, as students with well-defined career goals tend to select strands that align with their intended professions (Kilag et al., 2023). Furthermore, academically high-achieving students are more likely to opt for the STEM strand, utilizing their strengths—especially in science and mathematics—to advance their future career objectives (Nazareno et al., 2021).

In contrast, student's personality and habits that are suited to the strand they choose had a lowest mean of 3.44, standard deviation of 0.98 and interpreted as "High Influence". Additionally, the second lowest mean of 3.58, with standard deviation of 0.93 and interpreted as "High Influence" implies that student choose a strand because it has subjects where they could get good academic grades. The results emphasized that the Grade 11 STEM students consider their personality, habits and good academic grade in selecting a STEM strand in Senior High School.

Studies have shown that effective study strategies positively contribute to academic success, which is essential for students pursuing STEM degrees (Tus, 2020). Traits such as responsibility, organization, and diligence significantly impact both academic performance and preference for STEM fields. Personality traits also play a significant role in shaping students' interest and decisions to engage in STEM education (Coenen et al., 2021).

The level of strand preference in terms of individual interest was interpreted as "High Influence", with a section mean of 3.86 and standard deviation of 0.61, indicating that the students agree that individual interest influences the strand preference of students. Thus, in order to get ideas for choosing a strand in senior high school, students should consider their personality, habits and good academic grade in selecting a STEM strand.

Table 5. The Students' Entry Qualifications to STEM Strand in terms of General Average at Grade 10 in Science and Mathematics.

Students' General Average in Science and Mathematics	Frequency	Percentage	Interpretation
95-100	35	19.89%	Highly Qualified
90-94	130	73.86%	Qualified
85– 89	11	6.25%	Meets Minimum Qualifications
80-84	0	0%	Moderate Academic Performance
Below 79	0	0%	Need Significant Improvement
Total	176	100%	
Mean	4.14		Qualified

Table 5 presents the entry qualifications of Grade 11 STEM students from Banga National High School and Libertad National High School based on their Grade 10 general average in science and mathematics. The results show that 35 students (19.89%) had a general average between 95-100, categorized as "Highly Qualified." A significant majority of students, 73.86%, had averages between 90-94, classified as "Qualified," while 6.25% had averages between 85-89, described as "Meets Minimum Qualifications." No students had a general average below 84. Overall, students' entry qualifications to the STEM strand were interpreted as "Qualified," with a mean of 4.14, indicating that most students met the required qualifications based on their Grade 10 performance in science and mathematics.

The findings of table presented supports with DepEd Order No. 55 s. 2016 that Students who want to enroll in the STEM Strand must meet a certain cut-off score. In Grade 10, a final grade of 85 or higher should be earned in both math and sciences subjects. Additionally, learners should score at least 86 percentiles higher on the career assessment exam's STEM subtest. Finding students who possess the necessary knowledge and abilities for the demanding STEM curriculum is the goal of these requirements (Alvarez, 2024).

Table 6. The Students' Entry Qualifications to STEM Strand in terms of Entrance Exam Result.

Students' Grades	Frequency	Percentage	Interpretation
95-100	1	0.57%	Highly Qualified
90-94	19	10.80%	Qualified
85– 89	61	34.66%	Meets Minimum Qualifications
80-84	49	27.84%	Moderate Academic Performance
Below 79	46	26.14%	Need Significant Improvement
Total	176	100%	
Mean	2.32		Moderate Academic Performance

Table 7 shows the entrance exam results of Grade 11 STEM students from Banga National High School and Libertad National High School for STEM strand qualification. Only 1 student (0.57%) scored between 95–100, categorized as “Highly Qualified,” while 19 students (10.80%) scored between 90–94, labeled as “Qualified.” A larger group, 61 students (34.66%), scored between 85–89, meeting the minimum qualifications. However, a notable portion scored between 80–84 (27.84%) and below 79 (26.14%), described as “Moderate Academic Performance” and “Needs Significant Improvement,” respectively. Overall, the entrance exam performance was interpreted as “Moderate Academic Performance,” with a mean score of 2.32, indicating that more than half of the students struggled to meet the entrance exam qualifications for the STEM strand.

The 2018 Program for International Student Assessment (PISA) results showed that Filipino students ranked second to last globally in mathematics performance. This suggests that a significant number of students may lack the foundational skills and knowledge necessary to succeed in STEM entrance exams, which heavily prioritize math and science proficiency (Giangan & Gurat, 2022).

Research has identified several challenges Filipino students face in learning STEM courses, including difficulties with experimental skills, self-motivation, and sociocultural factors. These obstacles can hinder students' performance on entrance exams and impact their success in future STEM education (Rogayan et al., 2021).

Table 7. The Students’ Entry Qualifications to STEM Strand in terms of Entrance Interview Result

Students’ Grades	Frequency	Percentage	Interpretation
95-100	38	21.59%	Highly Qualified
90-94	84	47.73%	Qualified
85– 89	50	28.41%	Meets Minimum Qualifications
80-84	4	2.27%	Moderate Academic Performance
Below 79	0	0%	Need Significant Improvement
Total	176	100%	
Mean	3.89		Qualified

Table 7 presents the results of Grade 11 STEM students’ of Banga National High School and Libertad National High School entry qualifications to stem strand in terms of entrance interview result. Based on the result, 38 (21.59%) out of 176 Grade 11 STEM students have an entrance interview score range to 95 – 100 and described as “Highly Qualified”. This was followed by 84 (47.73%) students which have an entrance interview score range of 90 – 94 and described as “Qualified”. Moreover, there were 50 (28.41%) students which have an entrance interview score range of 85 – 89 and described as “Meets Minimum Qualifications”. There were also 4 (2.27%) students which have an entrance interview score range of 80 – 84 and described as “moderate academic performance”. Also, it reveals that there were no students got an entrance interview score below 79. Lastly, the students’ entry qualifications to stem strand in terms of entrance interview result was interpreted as “Qualified”, with a mean of 3.89. This implies that most of the students meet the entry qualifications to STEM strand in terms of entrance interview.

These findings are consistent with the study by Ferrer and Cruz (2017), which emphasized the need for well-defined screening criteria for student admissions into the STEM strand. Their research underscored the importance of career assessments to guide students in selecting the STEM strand based on their strengths, as well as the implementation of quantified evaluations of students' academic performance by grade level, a central feature of the spiral curriculum. Such measures ensure that students are adequately prepared for requirements like entrance interviews.

STEM education plays a crucial role in cultivating individuals equipped with 21st-century skills. Advances in science and technology are expected to foster essential competencies such as creativity, critical thinking, inquiry, reasoning, questioning, research, collaboration, and problem-solving. Consequently, students are expected to become productive and effective problem-solvers capable of thriving in the modern era (Cazu & Yalcin, 2021).

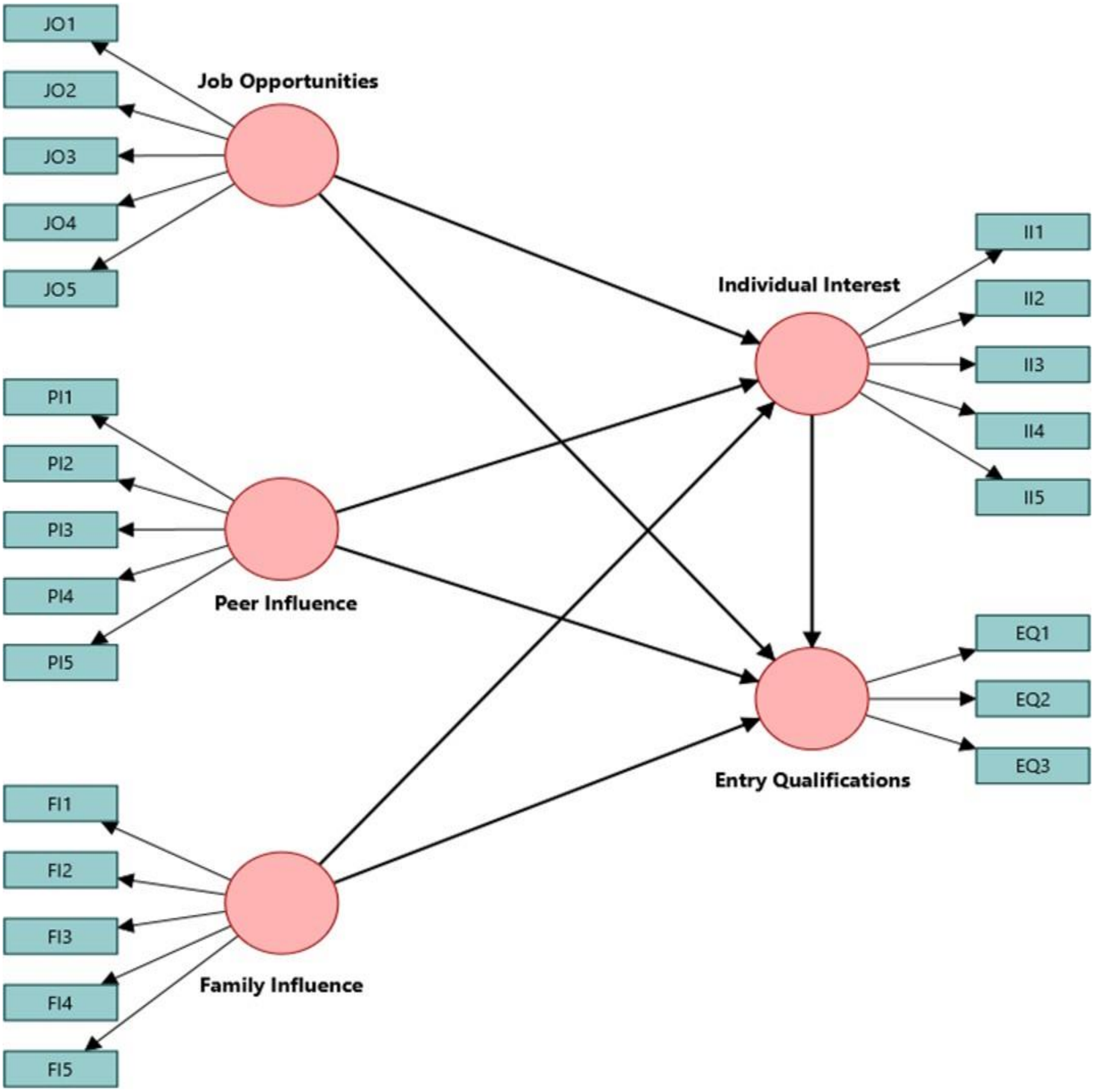

Figure 2. The Initial Structural Equation Model Before Refinement

Figure 2 illustrates the initial structural equation model (SEM) of the hypothesized relationships among various latent constructs. There are five (5) main constructs that are included in this model: *Job Opportunities, Peer Influence, Family Influence, Individual Interest,* and *Entry Qualifications.* Each of these constructs is represented by a latent variable associated with multiple observed variables. In the model, Job Opportunities, Peer Influence, and Family Influence serve as exogenous latent variables that influence Individual Interest and Entry Qualifications, which are endogenous latent variables.

Job Opportunities is measured by five observed variables (JO1 to JO5) and is hypothesized to directly influence both Individual Interest and Entry Qualifications. Similarly, Peer Influence (PI1 to PI5) and Family Influence (FI1 to FI5) are each measured by five observed variables and are also expected to have direct effects on Individual Interest and Entry Qualifications. Additionally, Individual Interest, measured by five observed variables (II1 to II5), is hypothesized to mediate the relationships between Job Opportunities, Peer Influence, and Family Influence with Entry Qualifications. Lastly, Entry Qualifications serves as the outcome variable in the model and is measured by three indicators (EQ1 to EQ3).

The initial SEM in Figure 3 may have contained redundant paths or variables, non-significant relationships, and potential multicollinearity issues, which could affect the model's fit and interpretability. Thus, it was subjected to a refinement process which will be discussed in the succeeding discussions. The refinement process aimed to achieve an optimized model that best represents the underlying relationships between the constructs while maintaining theoretical and empirical rigor.

Measurement Model Assessment

The measurement model assessment is a critical step in structural equation modeling (SEM) that evaluates the reliability and validity of the latent constructs. This process ensures that the observed variables accurately represent their respective constructs before proceeding with structural relationships. The assessment typically involves examining factor loadings, construct reliability, convergent validity, and discriminant validity to confirm that the measurement model is both statistically sound and theoretically meaningful. Adequate model fit indices further validate the appropriateness of the measurement model for subsequent structural analysis.

Construct Reliability and Validity

The initial assessment of the measurement model was conducted to evaluate its reliability and convergent validity before refinement. The results, presented in Table 8, indicate inconsistencies in internal consistency, composite reliability, and variance extracted across the constructs.

Table 8. Cronbach's Alpha, Composite Reliability, and Average Variance Extracted of the Initial SEM

Construct	Reliability			Validity
	Cronbach's alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Entry Qualifications	0.261	0.528	0.551	0.391
Family Influence	0.495	0.610	0.730	0.406
Individual Interest	0.706	0.728	0.808	0.462
Job Opportunities	0.473	0.602	0.640	0.315
Peer Influence	0.696	-0.250	0.059	0.179

Table 8 presents the measures of the reliability of constructs by examining internal consistency using Cronbach alpha, composite reliability, and construct validity by examining the convergent validity through average variance extracted. Cronbach's Alpha (α) values ranged from 0.261 to 0.706, with only Individual Interest (α = 0.706) meeting the acceptable threshold of 0.70 (Hair et al., 2022). Other constructs, including Entry Qualifications (α = 0.261), Family Influence (α = 0.495), Job Opportunities (α = 0.473), and Peer Influence (α = 0.696), exhibited lower reliability, suggesting that these constructs may have issues with internal consistency (Taber, 2018).

Composite reliability (ρc) values ranged from 0.059 to 0.808. Only Individual Interest (ρc = 0.808) surpassed the **0.70** recommended threshold, indicating strong construct reliability. Entry Qualifications (ρc = 0.551), Family Influence (ρc = 0.730), and Job Opportunities (ρc = 0.640) showed moderate reliability but fell short of the ideal threshold. Notably, Peer Influence (ρc = 0.059) demonstrated an exceptionally low value, suggesting substantial measurement issues.

Meanwhile, the AVE values ranged from 0.179 to 0.462, all of which fall below the recommended 0.50 threshold (Fornell & Larcker, 1981; Hair et al., 2022). The highest AVE value was observed for Individual Interest (AVE = 0.462), but it still did not meet the adequacy threshold. All other constructs, including Entry Qualifications (AVE = 0.391), Family Influence (AVE = 0.406), Job Opportunities (AVE = 0.315), and Peer Influence (AVE = 0.179), exhibited inadequate convergent validity, suggesting that a significant proportion of variance in the constructs is due to measurement error.

Cross Loadings

In order to determine if indicators were more strongly related with their assigned construct than with other

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constructs, discriminant validity evaluation required the use of the cross loadings table. In comparison to the other constructions, an indicator should ideally have higher loadings on its own construct.

Table 9. Discriminant Validity - Cross Loadings

	Entry Qualifications	Family Influence	Individual Interest	Job Opportunities	Peer Influence
EQ1	0.018	0.075	0.196	0.190	0.019
EQ2	0.939	-0.252	-0.040	0.135	0.053
EQ3	0.540	-0.099	0.003	0.019	0.097
FI1	-0.166	0.665	0.166	0.018	0.136
FI2	-0.260	0.764	0.112	-0.106	-0.123
FI3	-0.037	-0.007	0.153	0.106	0.132
FI4	-0.118	0.644	0.178	-0.054	0.011
FI5	-0.159	0.768	0.257	-0.028	-0.055
II1	-0.105	0.306	0.777	0.123	0.173
II2	0.039	0.150	0.734	0.229	0.251
II3	-0.102	0.118	0.592	0.083	0.077
II4	-0.007	0.264	0.743	0.129	0.188
II5	0.009	0.068	0.515	0.285	0.116
JO1	0.111	-0.104	0.247	0.844	0.095
JO2	-0.033	0.100	0.051	0.495	-0.011
JO3	0.098	0.006	0.132	0.677	0.043
JO4	0.003	-0.052	0.031	0.056	0.061
JO5	-0.002	0.155	0.077	0.395	0.089
PI1	0.073	0.094	0.146	0.009	0.681
PI2	0.000	0.264	-0.039	-0.142	-0.102
PI3	-0.084	0.228	0.056	-0.135	0.013
PI4	0.022	0.113	0.082	0.045	0.416
PI5	-0.043	0.127	-0.151	-0.110	-0.499

The results indicate several concerns regarding discriminant validity in the initial model. For Entry Qualifications (EQ), EQ2 (0.939) and EQ3 (0.540) load substantially onto their intended construct. However, EQ1 (0.018) does not exhibit a strong loading on Entry Qualifications, raising concerns about its validity.

For Family Influence (FI), items FI1, FI2, FI4, and FI5 demonstrate acceptable loadings above 0.60 on their intended construct, supporting their validity. However, FI3 (-0.007) does not strongly load onto Family Influence, suggesting potential measurement issues.

For Individual Interest (II), indicators II1 (0.777), II2 (0.734), and II4 (0.743) exhibit strong loadings. However, II5 (0.515) and II3 (0.592) have lower but still moderate loadings.

For Job Opportunities (JO), JO1 (0.844) and JO3 (0.677) exhibit high loadings, whereas JO2 (0.495), JO4 (0.056), and JO5 (0.395) show weak associations with their construct, raising concerns about their measurement

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reliability.

For Peer Influence (PI), PI1 (0.681) loads well on its construct, but PI3 (0.056), PI4 (0.082), and PI5 (-0.499) show substantial cross-loadings on other constructs, violating discriminant validity criteria.

Research on structural equation modeling (SEM) has demonstrated that factor loadings are essential for establishing construct validity. Items with strong loadings on their corresponding latent factors enhance the construct's dimensionality (Hair et al., 2021). Additionally, Zhao et al. (2020) noted that items with low loadings on their intended constructs may indicate potential discriminant validity issues. Weakly loaded items can overlap with other constructs, necessitating refinement or removal to improve the model's accuracy.

Table 10. Outer Loadings - Matrix

	Entry Qualifications	Family Influence	Individual Interest	Job Opportunities	Peer Influence
EQ1	0.018				
EQ2	0.939				
EQ3	0.540				
FI1		0.665			
FI2		0.764			
FI3		-0.007			
FI4		0.644			
FI5		0.768			
II1			0.777		
II2			0.734		
II3			0.592		
II4			0.743		
II5			0.515		
JO1				0.844	
JO2				0.495	
JO3				0.677	
JO4				0.056	
JO5				0.395	
PI1					0.681
PI2					-0.102
PI3					0.013
PI4					0.416
PI5					-0.499

Table 10 reveals the outer loadings matrix which shows the relationships between observed indicators and their respective latent constructs in the initial SEM model. Several items exhibited low or negative loadings, suggesting potential issues with construct reliability and validity that may require refinement.

For the Entry Qualifications construct, EQ1 demonstrated a very low loading (0.018), indicating that it may not

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adequately represent the construct. EQ2 showed a strong loading (0.939). High outer loadings indicate strong indicator reliability, while low loadings may suggest measurement issues requiring refinement (Henseler et al., 2023). While EQ3 had a moderate loading (0.540). This suggests that EQ1 should be considered for removal in future iterations to improve model fit. Weakly loaded items can blur discriminant validity and may need removal or modification to improve model precision (Zao et al., 2020).

The Family Influence construct showed mixed loadings. FI1, FI2, FI4, and FI5 demonstrated moderate to high loadings (ranging from 0.644 to 0.768), supporting their relevance. However, FI3 exhibited a near-zero loading (-0.007), suggesting it should be reviewed or removed from the model.

Individual Interest loadings were similarly varied. II1, II2, and II4 exhibited strong loadings (0.777, 0.734, and 0.743, respectively), indicating their adequacy for the construct. II3 and II5 had lower loadings (0.592 and 0.515), suggesting the need for refinement or further assessment.

For Job Opportunities, JO1 demonstrated a strong loading (0.844), supporting its contribution to the construct. However, the remaining items (JO2, JO3, JO4, and JO5) had weak or low loadings (ranging from 0.056 to 0.677), indicating the need for potential revision or removal.

Lastly, Peer Influence loadings showed significant variability. PI1 had a strong loading (0.681), supporting its relevance. However, PI2, PI3, and PI5 had low or negative loadings (-0.102, 0.013, and -0.499), raising concerns about their validity as indicators of this construct.

Figure 3. The Initial SEM with Labeled Outer Loadings and AVE

Figure 3 presents the results of the outer loadings which represents the strength of the relationship between observed indicators and respective latent constructs. These loadings are typically evaluated to ensure that they meet a threshold of reliability, often around 0.70. Thus, loadings at least 0.5 was considered when the AVE resulted to 0.50 up and exploratory research in nature (Hair et al., 2020).

Refinement Process

The indicators on job opportunities JO1 (0.844) and JO3 (0.677) have moderate to strong loadings, indicating that strength of the relationship between each indicator and its associated construct have a reasonable level of reliability. Indicators JO2 (0.495), JO4 (0.056), and JO5 (0.395) showed a weaker loading, thus they are less indicators of job opportunities construct and are needed to be removed as indicators of the construct. Based on the results indicators PI1 (0.681) and PI4 (0.416) have weak to moderate loadings. PI4 (0.416) indicator was theoretically important, and might retain loadings in the 0.40 – 0.49 range, indicating a reasonable level of reliability (Hair et al., 2020). Indicators PI2 (-0.102), PI3 (0.013) and PI5 (-0.499) shows weaker loadings; thus, they are less reliable indicators of Peer Influence and are needed to be discarded as indicators of the construct. Also, the indicators FI1 (0.665), FI2 (0.764), FI4 (0.644) and FI5 (0.768) fell the accepted threshold of at least 0.5 and above 0.7, indicating Family Influence construct have a reasonable level of reliability. While indicator FI3 (-0.007 showed less reliable indicator of Family Influence and was needed to be removed as indicators of

the construct (Hair et al., 2020). Moreover, the results of Individual Interest construct indicators II1 (0.777), II2 (0.734) and II4 (0.743) showed a reasonable level of reliability with strong loadings while II3 (0.592) and II5 (0.515) have moderate loadings. Additionally, the results of Entry Qualifications construct indicators EQ2 (0.939) and EQ3 (0.540), showed a reasonable level of reliability from moderate to strong loadings. Thus, only indicator EQ 1 (0.018) showed a less reliable indicators of Entry Qualifications.

Moreover, the Average Variance Extracted (AVE) values of Entry Qualifications (0.0.599), Family Influence (0.527), Individual Interest (0.617), Job Opportunities (0.618) and Peer Influence (0.631) exceeded the minimum threshold of 0.50, demonstrated sufficient convergent validity. Given that further item removal or modifications would undermine the theoretical completeness of this construct (Hair et al., 2020). Moreover, study suggests that while an AVE of ≥0.50 is ideal, slightly lower values may be acceptable if composite reliability and factor loadings are adequate (Hair et al., 2017).

Table 11. The Construct Reliability and Validity of the Refined SEM.

Constructs	Cronbach's alpha (α)	Composite reliability (ρ_a)	Composite reliability (ρ_c)	Average variance extracted (AVE)
Entry Qualifications	0.361	0.444	0.742	0.599
Family Influence	0.698	0.717	0.815	0.527
Individual Interest	0.690	0.698	0.828	0.617
Job Opportunities	0.385	0.389	0.764	0.618
Peer Influence	0.423	0.448	0.772	0.631

Table 11 presents measures of the reliability of refined constructs by examining their internal consistency through Cronbach alpha and composite reliability; and their construct validity by examining their convergent validity through average variance extracted.

Entry Qualifications showed low internal consistency with Cronbach's alpha of 0.361, below the recommended threshold of 0.70 (Nunnally, 1978). Similarly, composite reliability (ρ_a = 0.444) was low. However, composite reliability (ρ_c = 0.742) and AVE (0.599) exceeded the minimum thresholds, indicating that this construct has achieved sufficient convergent validity. Despite the low alpha, further refinement is not feasible without significant loss of theoretical meaning, so the construct is retained. Study of Hair et al. (2021) explains that composite reliability (ρ_c) is a more appropriate measure of internal consistency than Cronbach's alpha (ρ_a), especially in SEM. It also states that ρ_c values above 0.70 are acceptable, even if α is lower. Moreover, study highlights that Cronbach's alpha tends to underestimate reliability, whereas composite reliability provides a more

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accurate assessment (Henseler et al., 2015).

Family Influence demonstrated moderate reliability, with Cronbach's alpha (0.698) and composite reliability (ρ_a = 0.717) nearing the recommended thresholds. Composite reliability (ρ_c = 0.815) and AVE (0.527) confirmed that the construct has adequate reliability and convergent validity. The overall results suggest this construct is acceptable as is.

Individual Interest exhibited satisfactory reliability and validity. Cronbach's alpha (0.690) and composite reliability (ρ_a = 0.698) were near acceptable thresholds, while ρ_c = 0.828 and AVE (0.617) indicated strong internal consistency and convergent validity. No further modifications are necessary.

Job Opportunities showed low internal consistency with Cronbach's alpha (0.385) and ρ_a = 0.389. However, composite reliability (ρ_c = 0.764) and AVE (0.618) demonstrated sufficient convergent validity. Given that further item removal or modifications would undermine the theoretical completeness of this construct, it is retained in the final model.

Peer Influence had a Cronbach's alpha of 0.423 and composite reliability (ρ_a = 0.448), both below conventional thresholds. Nevertheless, composite reliability (ρ_c = 0.772) and AVE (0.631) indicated adequate convergent validity. Since further refinement would compromise the conceptual clarity of the construct, it is accepted as part of the final model.

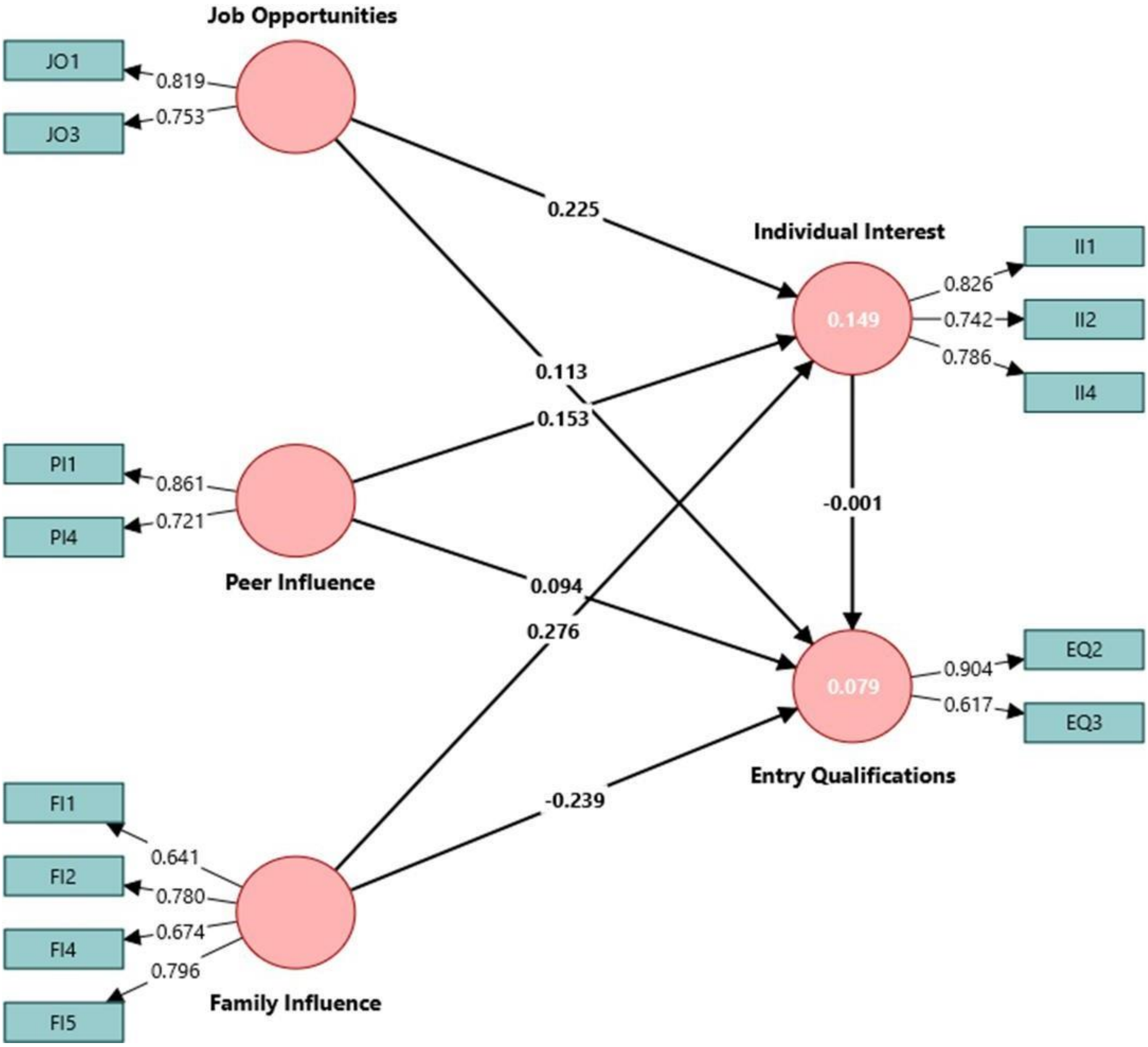

Figure 4. The Structural Equation Modelling of Students' Strand Preference in STEM

Figure 4 shows the refined structural equation modeling of five constructs with outer loadings, which indicate the degree of correlation between the corresponding latent constructions and observed indicators. As a result, average variance extracted (AVE) data were also displayed to show how much of the variance caused by measurement error was identified by the construct. The loadings were assessed to make sure they meet a threshold of reliability, which is typically approximately 0.70. Hence, loadings of at least 0.5 was also considered when the AVE resulted to 0.50 up (Hair et al., 2020).

Based on the results only JO1 (0.819) and JO3 (0.753) indicators of job opportunities construct that indicates the strength of the relationship between each indicator associated construct have a reasonable level of reliability. The peer influence construct revealed that indicators PI1 (0.861) and PI4 (0.721) have moderate to strong loadings, indicating a reasonable level of reliability (Hair et al., 2020). Also, the indicators FI1 (0.641), FI2 (0.780), FI4 (0.674) and FI5 (0.796) have moderate to strong loadings, indicating a reasonable level of reliability Furthermore, the results of individual interest construct indicators II1 (0.826), II2 (0.742) and II4 (0.786) showed a reasonable level of reliability from moderate to strong loadings. Moreover, the indicator of entry qualifications EQ2 (0.904) and EQ3 (0.617) have moderate to strong loadings, indicating a reasonable level of reliability.

Furthermore, based on standardized path coefficient (total effects), the SEM results showed that family influence negatively affects students' entry qualifications but positively impacts their individual interest in STEM. Job opportunities and peer influence do not improve entry qualifications, but both significantly increase individual interest. Meanwhile, individual interest does not significantly affect entry qualifications. These findings highlight that while external factors like family, peers, and job prospects boost students' interest in STEM, they do not necessarily enhance their academic readiness for the strand.

Structural Model Assessment

Structural Model Assessment is a crucial step in Structural Equation Modeling (SEM), where the relationships between latent variables are evaluated. It helps determine the validity, reliability, and predictive power of the proposed model.

Table 12. The Fit Indices of the Refined Structural Equation Model

Fit Index	Saturated model	Estimated model	Recommended Threshold
Standardized Root Mean Square Residual (SRMR)	0.098	0.098	≤ 0.08 (acceptable), ≤ 0.10 (marginal)
Squared Euclidean Distance (d_{ULS})	0.872	0.872	Lower values preferred
Geodesic Distance (d_G)	0.260	0.260	Lower values preferred
Chi-square (χ^2)	346.281	346.281	
Normed Fit Index (NFI)	0.179	0.179	≥ 0.90 (good fit)

Table 12 presents the fit indices for the saturated and estimated models. The following indices were used to assess the overall fit of the refined Structural Equation Model (SEM). The SRMR value for both the saturated and estimated models was 0.098. Values closer to zero indicate a better fit, with values less than 0.08 generally considered indicative of a good fit (Kenny, 2024), a value below 0.10 is often deemed acceptable, especially for complex models. This suggests an acceptable fit between the data and the model.

The d_{ULS} value was 0.872 for both models. While there is no universal threshold, lower values generally indicate better model fit. Given the limitations of model refinement, this value is considered acceptable.

The d_G value was 0.260 for both models. Similar to d_{ULS}, lower values are preferred. This value is within a reasonable range for a complex model, indicating acceptable fit.

The chi-square value was 346.281. The chi-square statistic tends to yield significant p-values with larger sample sizes, potentially indicating poor model fit even when the model is appropriate. This phenomenon occurs because, as the sample size increases, the test becomes more capable of detecting trivial discrepancies between the model and the observed data, leading to significant chi-square values (Alavi et al., 2020). Therefore, relying solely on chi-square for model evaluation may be misleading.

The NFI value for the model was 0.179, which is below the commonly accepted threshold of 0.90 for good fit (Bentler & Bonett, 1980). While this indicates room for improvement, further refinement is not feasible without compromising the theoretical integrity of the model. Moreover, modifying a model solely to achieve better fit indices can lead to overfitting and detract from the underlying conceptual framework (Kline, 2016). Likewise, Hair et al. (2019) caution that preserving theoretical consistency should take precedence over adjustments that merely improve fit statistics, as such changes might undermine the substantive meaning of the model.

Table 13. Path Coefficients (Direct Effects)

Predictor Variable -> Outcome Variable	Standardized path coefficient (β)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Family Influence -> Entry Qualifications	-0.239	-0.248	0.079	3.037	0.002
Family Influence -> Individual Interest	0.276	0.287	0.085	3.249	0.001
Individual Interest -> Entry Qualifications	0.000	-0.001	0.091	0.001	0.999
Job Opportunities -> Entry Qualifications	0.111	0.121	0.089	1.246	0.213
Job Opportunities -> Individual Interest	0.226	0.231	0.078	2.894	0.004
Peer Influence -> Entry Qualifications	0.095	0.095	0.087	1.092	0.275
Peer Influence -> Individual Interest	0.153	0.163	0.068	2.238	0.025

Table 13 shows the path coefficients (direct effects) that represent the strength and direction of the relationships between latent variables—family influence, peer influence, job opportunities, and individual interest—relate to students' entry qualifications and individual interest in the STEM strand. Notably, the relationship between family influence and entry qualifications was significantly negative ($\beta = -0.239$, $p = 0.002$), suggesting that higher family involvement may correspond to lower academic performance or preparedness for STEM. This could be due to parents or family members encouraging strand choices based on personal bias, perceived prestige, or future stability—rather than a student's actual capability or academic readiness. Despite this negative effect on entry qualifications, family influence had a significant positive effect on individual interest ($\beta = 0.276$, $p = 0.001$), showing that supportive or aspirational family environments can help ignite or strengthen a student's personal motivation and curiosity toward STEM. This suggests that while family influence discourages entry qualifications, it fosters individual interest. Kim and Lee (2020) found that strong parental expectations and involvement were linked to higher student interest in science-related fields, but they also observed that excessive pressure was associated with lower performance on standardized academic assessments. Leung and Shek (2019) reported that while a supportive family environment can enhance adolescents' career interests, overbearing family pressure may negatively impact their academic achievement, potentially due to heightened stress and performance anxiety.

However, individual interest itself had no significant direct effect on entry qualifications ($\beta = 0.000$, $p = 0.999$), indicating that having strong personal interest alone is not enough to boost academic performance or qualifications for STEM. This points to a possible disconnect between motivation and actual preparedness, suggesting that while interest can inspire students, it may need to be paired with academic support and resources to translate into measurable readiness for STEM programs. Muenks et al. (2018) found that the predictive power of individual interest on academic achievement often diminishes when factors like self-regulated learning and cognitive engagement are accounted for. Similarly, Anderman and Anderman (2019) reported that the relationship between personal interest and academic performance tends to be indirect, mediated by persistence and learning strategies, rather than exhibiting a direct effect.

Thus, Job opportunities had a non-significant impact on entry qualifications ($\beta = 0.111$, $p = .213$), suggesting that awareness of future employment prospects does not directly enhance a student's qualification for STEM. However, job opportunities had a significant positive impact on individual interest ($\beta = 0.226$, $p = 0.004$). This means that when students perceive strong career pathways and job potential in STEM, their interest in the strand tends to increase—though it doesn't necessarily correlate with improved academic qualifications. Chen and Wang (2021) found that adolescents' perceptions of job opportunities significantly enhanced their career interests, while the effect on their academic performance or entry qualifications was minimal. Similarly, Green and Martin (2020) reported that although favorable job market conditions can stimulate greater individual interest in certain fields, such external cues do not necessarily translate into improved academic credentials at the entry level.

Furthermore, peer influence showed no significant effect on entry qualifications ($\beta = 0.095$, $p = 0.269$), indicating that encouragement or opinions from peers do not directly influence academic readiness or the likelihood of meeting STEM strand requirements. However, peer influence was found to have a significant positive effect on individual interest ($\beta = 0.153$, $p = 0.025$). This implies that social interactions, peer inspiration, and group norms may play a crucial role in shaping a student's interest in STEM-related topics, even if they don't impact academic preparedness. Moreover, peer influence plays a more crucial role in shaping interest rather than directly influencing qualifications. Leung and Shek (2019) found that peer support significantly bolstered academic motivation and interest, whereas its direct association with objective performance indicators was less pronounced. Similarly, Wentzel and Wigfield (2017) emphasize that while peers contribute to an engaging learning environment and heightened interest, their influence on measurable academic qualifications is relatively limited.

Table 14. Specific Indirect Effects

Predictor Variable -> Outcome Variable	Standardized path coefficient (β)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Job Opportunities -> Individual Interest -> Entry Qualifications	0.000	0.000	0.022	0.001	0.999
Peer Influence -> Individual Interest -> Entry Qualifications	0.000	0.001	0.016	0.001	0.999
Family Influence -> Individual Interest -> Entry Qualifications	0.000	-0.001	0.028	0.001	0.999

Table 14 shows the specific indirect effects which reveals the influence of an independent variable (exogenous variable) on a dependent variable (endogenous variable) through a particular mediator or sequence of mediators. All indirect paths—job opportunities → individual interest → entry qualifications, peer influence → individual interest → entry qualifications, and family influence → individual interest → entry qualifications—had standardized path coefficients of 0.000, indicating no mediation effect. Additionally, the p-values for all three paths were 0.999, which suggests that these indirect effects are not statistically significant.

These findings indicate that individual interest does not serve as a mediating factor between these predictors and entry qualifications. In other words, while some of these predictors may directly influence individual interest (as shown in previous results), this interest does not translate into improved entry qualifications. This result suggests that other factors may play a more significant role in influencing entry qualifications.

Based on the study of Han et al. (2023), using total effect testing merely may lead to the incorrect indication of mediation when none occurs. In order to avoid drawing erroneous assumptions about the nature of the interactions between variables, it shows that an independent variable should not be regarded as a mediator until there is a large indirect influence. Moreover, in the study of Yuan and Qu (2023) examine the difficulties posed by confounding in mediation analysis and present a framework for dealing with latent confounders. Their research emphasizes how crucial it is to accurately identify mediators in order to prevent skewed estimates of causal effects. They warn that making the assumption that an independent variable acts as a mediator without the necessary validation may significantly distort the results.

Table 15. Total Effects

Predictor Variable -> Outcome Variable	Standardized path coefficient (β)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Family Influence -> Entry Qualifications	-0.239	-0.249	0.075	3.166	0.002
Family Influence -> Individual Interest	0.276	0.287	0.085	3.249	0.001
Individual Interest -> Entry Qualifications	0.000	-0.001	0.091	0.001	0.999
Job Opportunities -> Entry Qualifications	0.111	0.122	0.084	1.321	0.186
Job Opportunities -> Individual Interest	0.226	0.231	0.078	2.894	0.004
Peer Influence -> Entry Qualifications	0.095	0.095	0.086	1.106	0.269
Peer Influence -> Individual Interest	0.153	0.163	0.068	2.238	0.025

Table 15 reveals the total effect of an independent variable on a dependent variable is the sum of all direct and indirect effects. It represents the overall impact of the independent variable on the dependent variable, considering both mediated and non-mediated pathways.

Family Influence had a significant negative effect on entry qualifications (β = −0.239, p = 0.002), suggesting that greater family influence is associated with lower entry qualifications. Excessive parental pressure could negatively impact performance (Jomuad & Paclipan, 2020). Moreover, it also had a significant positive effect on individual interest (β = 0.276, p = 0.001), indicating that family influence fosters individual interest. Individual Interest had no significant effect on entry qualifications (β = 0.000, p = 0.999), meaning that personal interest does not translate into improved entry qualifications. Job opportunities had no significant effect on entry qualifications (β = 0.111, p = 0.186), suggesting that job opportunities did not translate into improved entry qualifications. Thus, it also had a significant positive effect on individual interest (β = 0.226, p = 0.004), indicating that job opportunities foster individual interest. Furthermore, peer influence had no significant effect on entry qualifications (β = 0.095, p = 0.269), suggesting that peer influence did not translate into improved entry qualifications. Thus, it had a significant positive effect on individual interest (β = 0.153, p = 0.025), indicating that peer influence fosters individual interest. Findings indicated that peer influence had a significant effect on academic performance, suggesting that peers play a crucial role in shaping academic outcomes (Sierra et al., 2021).

Table 16. R-square Values

Latent Variable	Effect Size (R^2)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Entry Qualifications	0.079	0.113	0.038	2.053	0.040
Individual Interest	0.149	0.182	0.055	2.698	0.007

Table 16 shows the measures how well the outcome variables in the model explain the variability of their respective predictors. The R-square value for entry qualifications is 0.079, indicating that approximately 7.9% of the variance in entry qualifications was explained by the predictor variables. This suggests a weak effect size (Cohen, 1988). The t-statistic of 2.053 and the corresponding p-value of 0.040 confirm that this effect is statistically significant. Furthermore, the R-square value for individual interest is 0.149, indicating that approximately 14.9% of the variance in individual interest was explained by the predictor variables. The t-statistic of 2.698 and the corresponding p-value of 0.007 confirm that this effect is statistically significant. Hair et al. (2019) noted that in many behavioral studies, the proportion of explained variance can be relatively low, reflecting the complexity and multidimensionality of the phenomena under investigation. This may due to the influence of many unmeasured factors. Even lower R^2 values can be considered meaningful when the paths are statistically significant, as they indicate that the predictors have a reliable, albeit small, effect on the outcome. Similarly, Kline (2016) points out that while higher R^2 values are ideal, lower values are often acceptable in complex models where numerous unmeasured variables may be influencing the outcome.

The Structural Equation Model (SEM) from this study can be used to develop career guidance modules and early screening tools for student placement. These tools would focus on key factors like job opportunities, personal interest, family and peer influence, and academic readiness. They can help counselors provide targeted support to students before strand selection. The SEM also supports creating parent and peer engagement activities, such as seminars and mentoring programs, to build a more supportive learning environment. Overall, the model offers useful insights for school leaders and curriculum developers in designing programs and policies that align with students' interests and future career demands.

CONCLUSION

The study found that job opportunities are the most influential factor in Grade 11 students' preference for the STEM strand, underscoring the importance of career guidance. School counselors should highlight career prospects, job stability, and work environments, while curriculum developers can integrate career exploration early in senior high school. Family and peer influences were seen as neutral—recognized but not heavily relied upon—though they still shape students' perceptions. Counselors should guide family involvement constructively, and schools should align parent expectations with students' strengths through engagement programs. Likewise, Encouraging peer-led STEM activities can nurture interest organically. Individual interest had a strong impact, pointing to the need to foster students' curiosity and strengths. Career guidance should include self-assessments and interest-based learning opportunities. Overall, the study highlights the need for targeted support through career guidance, family involvement, peer engagement, and personal development to help students make informed STEM strand choices.

The study revealed that most Grade 11 students met STEM entry qualifications based on their Grade 10 performance in math and science, showing strong academics. However, many struggled with the entrance exam, suggesting a need for better preparatory support. Schools should reassess exam fairness and offer support programs to improve qualification rates. In contrast, most passed the entrance interview, indicating strong motivation. The findings highlight the importance of improving academic preparation and assessment strategies to help students confidently meet STEM strand requirements.

The study found that family influence had a negative effect on entry qualifications but a positive impact on individual interest, suggesting that while family expectations may create pressure, they also boost STEM interest. However, individual interest alone did not predict academic readiness, and neither job opportunities nor peer influence directly affected qualifications. Individual interest also did not mediate these relationships. Overall, the results show that while external influences shape students' interest in STEM, they do not directly improve academic qualifications, pointing to the importance of other contributing factors for STEM eligibility.

The refined Structural Equation Model (SEM) confirmed that the indicators for job opportunities, peer influence, family influence, individual interest, and entry qualifications are reliable, establishing convergent validity. The model effectively explains students' STEM strand preferenc**e**, but the R-square values indicate that other factors may also impact entry qualifications and interest. Overall, the study highlights that while external influences shape STEM interest, they do not fully determine academic readiness, stressing the need for stronger preparation in math and science.

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