Psychological Constructions in Influencing Female Intentions to Pursue Science, Technology, Engineering and Mathematics (STEM) Fields

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Abstract: Although there is a surge in female students attaining bachelor's degrees, their involvement in Science, Technology, Engineering, and Mathematics (STEM) in China remains disproportionately low, posing a continuing concern. This study explores the reasons behind this gender gap and identifies factors influencing females' intentions to pursue STEM Education in China. The study aims at investigating the level of psychological constructs related to identity, interest, the role of self-concept, and self-efficacy. It seeks to identify the differences in these psychological constructs based on interests and to examine the relationships between variables within psychological construction. The independent variables include identity, interests, the role of self-concept and self-efficacy. Data were gathered from 64 females with educational qualifications from different levels in Cheng Gong districts in Yunnan province, China. The data were analysed using descriptive statistics and inferential analysis including one-way MANOVA and Pearson correlation analysis. The findings reveal that overall identity, interest, self-concept, and self-efficacy of female students towards STEM is at a moderately high level. The results of the study suggest that female students with an interest in arts exhibit higher scores in identity, interests, and the role of self-concept compared to respondents with an interest in science. The relationships between identity and interests, the role of self-concept, and self-efficacy are very strong. Hence policymakers are encouraged to propose key initiatives to empower more female students to pursue STEM.

Keywords: Science, Technology, Engineering and Mathematics (STEM), Female Intentions, Identity, Role of Self-concept, Self-efficacy, Interest

1. Introduction

In the last decade, Science, Technology, Engineering, and Mathematics (STEM) education has sparked and garnered increasing curiosity (Qiao, 2021). By means of equipping the needed knowledge, competencies, skills and capacities, STEM education has emerged and established scientific fundamentals in favour of humanity and society (Peng, 2022). In consequence, the worldwide demands increased STEM cultured and knowledgeable leaders, experts, professionals and individuals (Wen et al., 2023) and its relevance certainly should not be ignored and compromised.

China has transitioned from a centralised economy to a market-driven model, a shift that has contributed to an increased emphasis on STEM. This transformation is crucial as the globalised economy increasingly relies on technological and scientific breakthroughs. At present, China's STEM education progress differs from conventional initiatives in four key aspects: (a) an expanded realm of students' intellectual exposure to learning, (b) the prominent, influential and accelerating use of educational informatics and technology, (c) evolving needs from branches of knowledge and numerous recruitment regions to intensify STEM cultivation and literacy among all students, specifically females and minorities, and (d) escalating calls for integrated STEM education and the corresponding desire and necessity to cross-examine and chronicle how students understand and discover learning in unified modes (Honey et al., 2014; National Research Council, 2013).

A report disseminated by the American Association of University Women (AAUW), revealed that an increase in female pursuit, interest and engagement in STEM education can result in accelerated success in innovation together with competitive capacity (AAUW, 2010). The report also indicated that, to depict, sustain and fulfil the desires and requirements of female clientele, it is crucial that the STEM profession encompasses men and women in equitable, relative and balanced figures. Peng (2022) additionally stressed the need and urgency for a diversified labour force that includes females. Thus, it can be asserted that STEM and females rely and depend on each other (Lee & Song, 2018).

Previous studies have demonstrated a growth in female involvement in STEM disciplines in recent years (Jackson & Wilton, 2017). Nevertheless, regardless of its significance and pertinence towards 21st-century hindrances, the lack of female involvement continues to exist and for this reason, gaps and inequalities between men and women prevail throughout the world (National Science Foundation, 2010). In recent years, female students have shown a lack of interest and involvement in STEM-associated professions, evident as early as the high school level (Liu & Yan, 2021; Jain et al., 2024). In 2019, females constituted merely 27% of the STEM profession in the United States of America (USA), the trendsetter in the field of science and technology (Martinez & Christnacht, 2021).

Due to this gender gap reported in STEM education, diverse global issues, including internal factors, have surfaced. For example, based on their involvement in STEM education and professions, the female populace tends to have insignificant incomes and fewer prospects for leadership or higher-order position in comparison with males. In addition, Ramsey (2018) mentioned that reasons for females opting for STEM-related professions are not limited to getting good wages and high positions; they must be well-versed in STEM so that they can be responsible and relied upon to spear-head scholarly, cultivated and efficacious life as stakeholders of STEM-originated products.

In the same vein, China has expanded into the world's superior institutions of higher learning, and the number of undergraduate and postgraduate degrees awarded by China in science and engineering has exceeded those of the United States. Accordingly, STEM publications in China have also consistently advanced, and China at present is the world's second-highest issuer of STEM publications (Zhong et al., 2019). Nevertheless, on the grounds of the conventional norm of gender disparity and socialisation based on gender, Chinese female involvement in STEM education has substantial opportunity to grow. In China, female scientists are marginalised, and the figure of high-profile and influential scholars and experts in the female scientific and high-tech cluster is comparably small. Science and technology are known as China's main frontier and expansion approach, and has a key role in economic production and social development and at some point, in the future, female involvement in STEM education influences the progress of females in scientific society.

A number of factors that led to underrepresentation of female involvement in STEM disciplines consist of those that are linked with identity, self-esteem, education, self-efficacy, society and culture (Yin-Wang, 2019). Female participation in STEM profession and education is crucial due to the

marginalisation that has been broadly investigated across the globe (Wang, 2020). Relatively, in the setting of female involvement in STEM education in China, scholars have researched and identified numerous factors. In the learning experience factor, Kiernan et al. (2022) explain that learning experiences may affect students' views, interest, selection of subjects, and self-efficacy. Students who possess optimistic experiences in the elementary school education STEM subjects have more inclination to continue STEM at tertiary level (Kiernan et al., 2022) and eventually select STEM-linked professions (Liu & Yan, 2021). On the other hand, Wang and Degol (2013) reported that enrolment into science and mathematics gave an important indication of students' admission into STEM fields than achievement in mathematics, initially viewed as the finest predictor. Wen et al. (2023) who investigated the effect of college experience on female students' self-perceived career readiness in STEM majors reported their exposure to curriculum extra-curricular involvement and support given by the faculty in facilitating STEM-related activities yield significant effect on female students. The researchers however mentioned that the gender gap still exists due to females possessing low self-perceived employability as compared to males. McNeill and Wei (2023) who investigated employment intentions of university STEM students in China and Scotland by studying and associating the reasons and intentions that influence them found that females in China were more reluctant about enrolling into STEM professions as compared to females in Scotland; however, the Chinese females studying in Scotland have parallel replies to Chinese females studying in China. The findings of this study reveal that females were less likely to opt for STEM-related professions as compared to males although the females had high ambitions for pursuing STEM-related professions. This gap in females existed because they had reservations and concerns regarding the reality and certainty towards these professions and environmental factors that discouraged females from pursuing STEM-related professions.

In addition to the job-related, identity, self-esteem, education, self-efficacy, society, culture and environmental factors, researchers have found a number of main variables that are circumstantial or contextual in nature, and that undoubtedly or destructively influence female students' choices to pursue STEM education or professions. For instance, individual feedback and upbringing contextual adaptability can influence students' involvement, experiences and attitudes toward STEM subjects (Ertl et al., 2017). Vondracek and Schulenberg (1986) shared that the individual feedback and upbringing contextual adaptability connect to the available possessions an individual observes as being supported in the environment they belong and the culture and cultural notions in which the individual is rooted (Kiernan et al., 2022). It is also correlated to socio-economic ranking and social acquaintances consequently signals a mutual connection to individual feedback. Females from minority groups who come from a lesser socioeconomic ranking are less inclined to continue a profession in STEM (Turnet et al., 2019). Gender stereotypes have the probability to reduce female's ambitions to pursue STEM professions (Graves, 2014). Contextual affordance is closely linked to the availability of learning exposure and experiences with past studies revealing that a number of STEM subjects are not given access to lower socio-economic females and groups (Cheryan et al., 2017). Rajendran and Zawawi (2019) projected that stress in the family can impact the emotional well-being of females employed in the Information and Communications Technology (ICT) field. Still, a number of factors appeared to be neglected and unexplored in the China context such as the psychological aspects of identity, interest, the role of self-concept, and self-efficacy (Brenøe & Zölitz, 2020; Guo et al., 2019). Thus, the objectives of the current research are to investigate the level of psychological factors for aspects of identity, interest, the role of self-concept, and self-efficacy, to identify the differences of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy based on interests and to examine the relationship between variables in psychological construction.

The current study has identified four psychological factors namely identity, interest, the role of self-concept and self-efficacy that can influence female decision to continue STEM education irrespective of the levels of education based on review of the literature. Self-efficacy refers to a person's aspirations and anticipation of accomplishment and achievements in STEM-linked subjects, for example 'get good grades in your STEM courses this semester'. Apparently, it was made known that females have low level of self-efficacy when it comes to STEM-linked aims and thus they gradually show less interest in STEM (Kuchkynka et al., 2021). Self-efficacy is an influential predictor concerning the choice of profession of females (Theobald et al., 2020), together with their perseverance in STEM education (Aulck et al., 2017).

When investigating the intent of elementary school students in continuing STEM education, Brown et al. (2016) reported a significant relationship between self-efficacy and intent.

Self-concept among females is an important factor which can be described as self-assurance in a female's capacity to attain and finish activities connected to STEM via the unification and execution of the mandatory competence and knowledge to achieve in STEM-linked subjects (Liu, 2023). Self-concept does not allude to performance in a specific field (Ertl et al., 2017). A study carried out by the OECD (2015) showed that females were reported to be over critical when it comes to relating to their STEM-linked self-concept in comparison to males. Therefore, the STEM-linked self-concept ought to influence the accomplishment level in STEM-linked subjects as mentioned by Ertl et al. (2017). Self-concept is parallel to self-efficacy; however, they vary from each other considerably (Pajares, 2004). STEM self-concept refers to the wide-ranging insights of a person on STEM education, while STEM self-efficacy is a person's anticipation and aspirations about his/her accomplishments in STEM. For example, an individual could explain that his/her STEM self-efficacy in a sentence as 'get good grades in your STEM courses this semester', while for STEM self-concept, an individual can express, 'I score good grades for STEM-related subjects in school' (Rittmayer & Beier, 2008). Thus, it could be concluded that a positive STEM self-concept will steer to positive STEM self-efficacy.

Fishbein and Ajzen (1977) explain that attitude is another vital variable highlighted in the Theory of Planned Behaviour, and attitude is well-defined in the same way of the belief of an individual regarding the aspects of some matters. In connection to STEM, attitude is explicitly known as the feelings, values, and beliefs possessed about STEM-linked fields or its effect on community or the experts (Elena Prieto-Rodriguez et al., 2022). Balta et al. (2023) mentioned attitude of an individual regarding STEM. Same as self-efficacy, influences their involvement, interest (Prieto-Rodriguez et al., 2022), belief and achievement (Bowman et al., 2021).

At the personal level, Heilbronner (2013) witnessed that an important determinant for females pursuing STEM disciplines is a heightened interest; contributing to an unprecedented increase in the number of females pursuing STEM (p. 52); and those competent females 'apparently have lack of fear from competition or some of the conventional impacts that in the past have led them to leave STEM disciplines (p. 52). On a personal note, it is significant to observe that person's interest has a high probability of being affected by environmental factors, and that females are not expected to be depending on being assertive, for the purpose to persevere in STEM disciplines (Baliyan & Mokoena, 2024). In essence, the persistent marginalisation of females compared to males in STEM disciplines highlights that personal factors are alone insufficient to overcome dearth of females in STEM. If females seem to show no interest to pursue STEM education, the personal factors must be addressed and researched.

In a similar vein, gender has been viewed as a social construct employed by children from pre-school age, for the purpose of comparing, classifying and distinguishing children from one another (Makarova & Herzog, 2015). Law et al. (2021) explain that boys and girls aged from 2 years are able to understand gender-based stereotyping; this is intensified by their communication with adults (Claro et al., 2016), and they begin to establish a stereotype (Wang & Degol, 2017) concerning the diverse activities, main roles, and professions (Master et al., 2017a).

STEM identity is ascertained as a pathway for individuals to construct the notion of adjusting within the confines of STEM disciplines; precisely, how the individuals adjust and develop 'meaning or connotation of experiences in science and how community constructs practical explanations (Singer et al., 2020). Traditionally, STEM identity constitution for inadequately represented students been made more difficult through the dearth of depiction of people in STEM disciplines, that principally encompass males (Bernard & Cooperdock, 2018). One of the academic challenges faced is the expanding STEM classrooms, the other being students themselves as well as the terminologies of the science and scientist. In other words, students fail to understand the terminologies used in STEM, or being STEM students, they do not understand the scientific terminologies as scientists should.

Living environments and learning can be better fostered as they facilitate students to nurture and improve positive STEM identities, and it is crucial to comprehend how these identities are formed via schools, colleges and universities. The three vital enablers in forming STEM identity are: (a) instructing for inclusion and diversity via acquaintance to role models (Johnson, 2012); (b) a person's feelings of belonging to schools, colleges and universities and to the STEM disciplines (Rainey et al., 2018); and (c) real-time learning exposure and experiences (Beier et al., 2019; Teoh et al., 2024). These different

enablers are not associated mutually, and specifically, inclusion and diversity are profoundly connected to feelings of belonging, specifically for persons who may not view their own identities echoed in the paramount STEM illustrations or in schools, colleges and universities.

Questions raised related to stereotypes are many times accepted, for instance, who should, who can, and is competent at STEM education which affects students' interest in STEM education (McGuire et al., 2020). There is a disagreement that the capacity to study, continue and excel in the STEM discipline can be perceived as 'gender innate' because of the fact that it is meant and reserved for males (McGuire et al., 2020). As a consequence, McGuire et al. (2020) expressed that female students had to endure and experience pain for permanent repercussions of these stereotypes for their involvement and inspiration in the STEM discipline. Gender stereotypes have been known to cause negative effects on female motivation and self-efficacy to continue STEM education and career as divulged by Cundiff et al. (2013) and Martiny (2017). This was well supported by Garriot et al. (2017) in their study that reported how gender stereotypes substantially predict self-efficacy in STEM, which is known to be a sturdy predictor of professional goals.

Theoretical Framework

The theoretical framework of this present study is grounded on two theories namely the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and Social Cognitive Career Theory (SCCT) (Lent & Brown, 2019). Bosnjak et al. (2020) explain that the Theory of Planned Behaviour (TPB) theorises that intention is the solid predictor of human behaviour and the underlying cognitive processes where personal standards, attitude, and observed behavioural control predict the intention. Actual examples of human behaviour include aspects of norms, goals, attitude and the sense of control over their actions, are all interrelated (Ajzen, 1991). The Theory of Planned Behaviour has predictive ability for STEM education selections. The Social Cognitive Career Theory (SCCT) is an important theoretical foundation for this research (Lent & Brown, 2019) and this theory posits that an individual's decision to select a specific profession route is the final result of the combination among numerous cognitive and environmental factors together with immediate actions and behaviours (Brown & Lent, 2019). TPB and SCCT have played an important role in interpreting premediated cognitive selection of profession and human behaviour, correspondingly. Derived from these two theories and literature review, the projected theoretical framework for the current research has been represented in Figure 1, considering the proposed hypotheses are shown in Table 1.

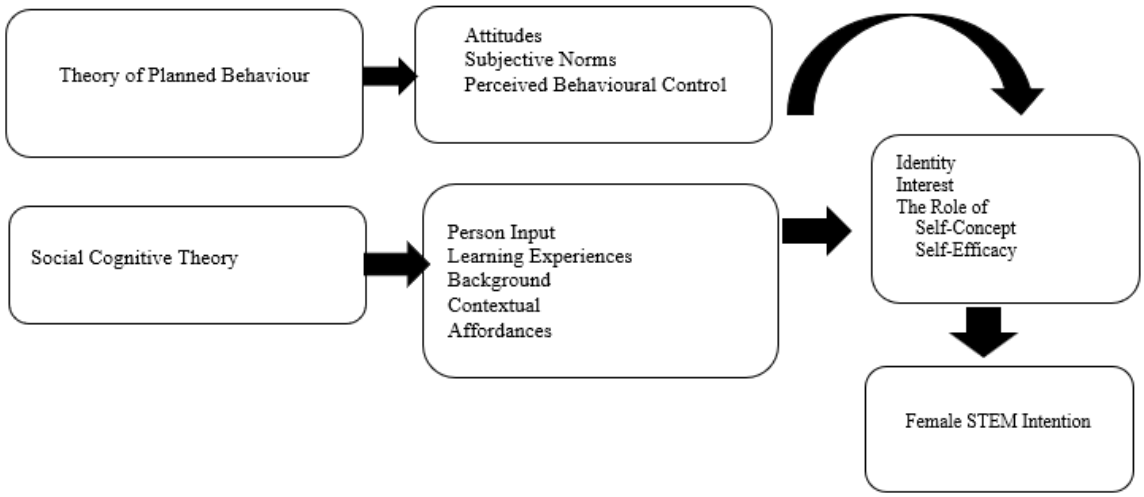

Fig. 1. Proposed Theoretical Framework

Table 1. Proposed Null Hypotheses

Null Hypothesis No.	Hypothesis Statement
Ho1	There are no significant differences in the psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy based on interests.
Ho2	There is no significant relationship among variables in psychological construction.

2. Methodology

A quantitative research design was employed in this study, and data were gathered through a survey questionnaire. The data were gathered from 64 female students who have obtained their educational qualifications from various levels in Cheng Gong districts in Yunnan province, China. A convenience sampling technique was used in this research and the data were collected by employing pre-validated scales using a five-point Likert scale. The researchers adapted the survey questions to align with the context of the current research that were deemed essential. Table 2 shows the variables, the basis from which the instruments were adopted, the number of items, and an example of a sample item taken from the questionnaire. The data were analysed statistically using SPSS version 22. Descriptive statistics were used to quantify the characteristics of the data and highlight numerical features, which are deemed the most important (Antonius, 2003). Inferential statistics were used to make inferences about the population based on the sample data. According to Antonius (2003), inferential statistics can be used to generate predictions of the population and make generalisation from the sample. The results and discussions are illustrated next.

Table 2. Adapted scales for all the constructs

Variable	Source	No. of Items	Example
Identity	Singer et al. (2020)	18	"I frequently encounter high-achieving STEM professionals who have achieved significant success."
Interest	Donme & Idin (2020)	9	"I will study more for STEM-related lessons."
Role of Self-Concept	Donme & Idin (2020)	25	"I learn better in STEM-related subjects compared to other subjects"
Self-Efficacy	Donme & Idin (2020)	7	"How confident are you that you can get good grades in your STEM courses this semester?"

3. Findings

The descriptive analysis is used to comprehensively describe the respondent profiles and address the research questions using the minimum score interpretation outlined in Table 3.

Table 3. Mean Score Interpretation

Mean Score	Interpretation
0.00 – 2.00	Low
2.01 – 3.00	Low Moderate
3.01 – 4.00	High Moderate
4.01 – 5.00	High

Inferential analysis is employed to elucidate the relationship between variables and answer research questions, utilising one-way MANOVA and Pearson correlation analysis. Interpretations are referenced in the table 4 below.

Table 4. Correlation Interpretation

r	Interpretation
0.0 – 0.19	Very Low
0.20 – 0.39	Low
0.40 – 0.59	Moderate
0.60 – 0.79	Strong
0.80 – 1.00	Very Strong

Demographic Profile

This study involves a total of 64 respondents. The demographic profiles of the respondents are detailed in Table 5.

Table 5. Profile Demography

Profile	Demography	Frequency	Percentage
Qualification	Certificate	3	4.7%
	Diploma	9	18.8%
	Degree	50	96.9%
	PhD	2	3.1%
Interest in	Arts	36	56.3%
	Science	28	43.8%

Based on Table 5, the study's demographic profile reveals the academic qualifications of respondents, with 3 (4.7%) holding certificates, 9 (18.8%) with diplomas, 50 (96.9%) possessing degrees, and 2 (3.1%) having PhDs. In terms of interests, 36 (56.3%) of respondents expressed an interest in arts while 28 (43.8%) showed an interest in science.

Psychological Construction

Research Objectives 1: To investigate the level of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy.

Overall, the psychological construction has four aspects, namely identity, interest, the role of self-concept, and self-efficacy. Table 6 shows a detailed descriptive analysis, including frequency values, percentages, mean, standard deviation, and interpretation for each of these pivotal aspects.

Table 6. Identity

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
In future, being a STEM professional is an important part of my self-image.	2 (3.1%)	3 (4.7%)	10 (15.6%)	25 (39.1%)	24 (37.5%)	4.03	1.00	High
Having more people with STEM background makes me feel more like a STEM professional.	0	8 (12.5%)	8 (12.5%)	22 (34.4%)	26 (40.6%)	4.03	1.02	High
My ethnic identity is an important part of who I am.	4 (6.3%)	3 (4.7%)	7 (10.9%)	27 (42.2%)	23 (35.9%	3.96	1.11	High Moderate
I enjoy studying with other students in a group.	2 (3.1%)	8 (12.5%)	0	28 (43.8%)	26 (40.6%)	4.06	1.09	High
I often hear or read about high-achieving people of colour.	2 (3.1%)	4 (6.3%)	9 (14.1%)	32 (50%)	17 (26.6%)	3.90	0.97	High Moderate
Thinking of myself working in STEM field is compatible with other aspects of my background.	0	1 (1.6%)	11 (17.2%)	29 (45.3%)	23 (35.9%)	4.15	0.76	High
Other students in class take my suggestions seriously.	2 (3.1%)	4 (6.3%)	8 (12.5%)	35 (54.7%)	15 (23.4%)	3.89	0.94	High Moderate
I am confident in my ability to succeed in STEM subjects.	4 (6.3%)	7 (10.9%)	9 (10.9%)	28 (43.8%)	16 (25%)	3.70	1.15	High Moderate
I can effectively be a member of a team to design and build a hands-on project.	1 (1.6%)	7 (10.9%	3 (4.7%)	34 (53.1%	19 (29.7%)	3.98	0.96	High Moderate

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
I look forward to STEM courses.	2 (3.1%)	6 (9.4%)	9 (14.1%)	28 (43.8%)	19 (29.7%)	3.87	1.04	High Moderate
I intend to complete a degree in STEM courses.	7 (10.9%)	9 (14.1%)	12 (18.8%)	19 (29.7%)	17 (26.6%)	3.46	1.32	High Moderate
I am confident in my ability to succeed in my university STEM-related courses.	5 (7.8%)	7 (10.9%)	11 (17.2%)	26 (40.6%)	15 (23.4%)	3.60	1.19	High Moderate
I have a strong sense of belonging to the STEM community.	4 (6.3%)	9 (14.1%)	10 (15.6%)	25 (39.1%)	16 (25%)	3.62	1.18	High Moderate
It is my choice to study STEM subjects.	4 (6.3.%)	7 (10.9%)	5 (7.8%)	29 (45.3%)	19 (29.7%)	3.81	1.16	High Moderate
The STEM courses in high school will prepare me to attend college.	4 (6.3%)	2 (3.1%)	5 (7.8%)	32 (50%	21 (33.8%)	4.00	1.05	High
I can explain STEM-related subjects to my friends to help them understand a problem.	5 (7.8%)	7 (10.9%)	8 (12.5%)	29 (45.3%)	15 (23.4%)	3.65	1.18	High Moderate
My gender identity is an important part of me being a STEM professional.	7 (10.9%)	14 (21.9%)	10 (15.6%)	19 (29.7%)	14 (21.9%)	3.29	1.32	High Moderate
I feel like I belong in the field of STEM.	2 (3.1%)	8 (12.5%)	12 (18.8%)	26 (40.6%)	16 (25%)	3.71	1.07	High Moderate
Identity						**3.82**	**0.80**	**High Moderate**

The descriptive analysis indicates that overall identity is at a moderately high level with a mean value of 3.82 and a standard deviation of 0.80. The item "Thinking of myself working in STEM field is compatible with other aspects of my background" has the highest mean value, standing at 4.15 with a standard deviation of 0.76, indicating a high level. Notably, 23 individuals or 35.9% expressed a "Strongly Agree" sentiment, while only 1 individual or 1.6% disagreed. Conversely, the item "My gender identity is an important part of me being a STEM professional" has the lowest mean value, reaching 3.29 with a standard deviation of 1.32, indicating a moderately high level. Interestingly, 7 individuals or 10.9% strongly disagreed, while 14 individuals or 21.9% strongly agreed with this statement.

Table 7. Interest

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
I can get good scores for STEM subjects.	0	8 (12.5%)	10 (15.6%)	34 (53.1%)	12 (18.8%)	3.78	0.89	High Moderate

I complete my assignments for STEM subjects.	2 (3.1%)	6 (9.4%)	7 (10.9%)	35 (54.7%)	14 (21.9%)	3.82	0.98	High Moderate
Engaging in STEM subjects is one of my future plans.	4 (6.3%)	7 (10.9%)	7 (10.9%)	32 (50%)	14 (21.9%)	3.70	1.12	High Moderate
I will study more for STEM-related lessons.	3 (4.7%)	8 (12.5%)	4 (6.3%)	33 (51.6%)	17 (26.6%)	3.79	1.10	High Moderate
If my scores are high in STEM-related courses, it will help me in my future life.	0	4 (6.3%)	2 (3.1%)	37 (57.8%)	21 (32.8%)	4.17	0.76	High
If I choose a STEM career, my parents will be glad.	2 (3.1%)	6 (9.4%)	8 (12.5%)	29 (45.3%)	19 (29.7%)	3.89	1.04	High Moderate
I am interested in STEM fields.	4 (6.3%)	4 (6.3%)	10 (15.6%)	30 (46.9%)	16 (25%)	3.78	1.09	High Moderate
I enjoy attending STEM-related courses.	3 (4.7%)	3 (4.7%)	7 (10.9%)	35 (54.7%)	16 (25%)	3.90	0.98	High Moderate
I am comfortable when I speak to teachers majoring in STEM subjects.	4 (6.3%)	3 (4.7%)	4 (6.3%)	34 (53.1%)	19 (29.7%)	3.95	1.06	High Moderate
Interest						**3.86**	**0.81**	**High Moderate**

The descriptive analysis indicates that overall interest is at a moderately high level with a mean value of 3.86 and a standard deviation of 0.81. The item "If my scores are high in STEM-related courses, it will help me in my future life" has the highest mean value, standing at 4.17 with a standard deviation of 0.76, placing it at a high level. Notably, 21 individuals or 32.8% expressed a "Strongly Agree" sentiment, while 4 individuals or 6.3% disagreed. On the other hand, the item "Engaging in STEM subjects is one of my future plans" has the lowest mean value, reaching 3.70 with a standard deviation of 1.12, also at a moderately high level. Interestingly, 4 individuals or 6.3% strongly disagreed, while 14 individuals or 21.9% strongly agreed with this statement.

Table 8. Role of self-concept

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
I score good grades for STEM-related subjects in school.	2 (3.1%)	7 (10.9 %)	6 (9.4%)	34 (53.1%)	15 (23.4%)	3.82	1.01	High Moderate
I learn better for STEM-related subjects compared to other subjects.	3 (4.7%)	15 (23.5 %)	12 (18.8%)	20 (31.3%)	14 (21.9%)	3.42	1.20	High Moderate

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
I feel comfortable in STEM subjects' classes.	1 (1.6%)	6 (9.4%)	8 (12.5%)	34 (53.1%)	15 (23.4%)	3.87	0.93	High Moderate
I often take part in class discussions.	3 (4.7%)	6 (9.4%)	2 (3.1%)	35 (54.7%)	18 (28.1%)	3.92	1.05	High Moderate
I stick to STEM subjects' problems without giving up.	1 (1.6%)	7 (10.9 %)	12 (18.8%)	28 (43.8%)	16 (25%)	3.79	0.99	High Moderate
I remember clearly what I learn for STEM subjects.	2 (3.1%)	8 (12.5 %)	7 (10.9%)	34 (53.1%)	13 (20.3%)	3.75	1.02	High Moderate
I volunteer to answer questions in STEM courses.	4 (6.3%)	7 (10.9 %)	12 (18.8%)	28 (43.8%)	13 (20..3%)	3.60	1.12	High Moderate
I do well in STEM subjects quizzes.	3 (4.75 %)	9 (14.1 %)	11 (17.2%)	28 (43.8%)	13 (20.3%)	3.60	1.10	High Moderate
I often ask questions when I don't understand.	3 (4.75 %)	4 (6.3%)	3 (4.75%)	32 (50%)	22 (34.4%)	4.03	1.03	High
I often submit homework on time.	2 (3.1%)	3 (4.75 %)	5 (7.8%)	33 (51.6%)	21 (32.8%)	4.06	0.94	High
I score good grades for STEM-related subjects in school.	3 (4.75 %)	6 (9.4%)	7 (10.9%)	34 (53.1%)	14 (21.9%)	3.78	1.04	High Moderate
I do better than others in class.	3 (4.75 %)	12 (18.8 %)	18 (28.1%)	20 (31.3%)	11 (17.2%)	3.37	1.11	High Moderate
I concentrate in STEM-related subjects in class.	2 (3.1%)	6 (9.4%)	2 (3.1%)	38 (59.4%)	16 (25%)	3.93	0.97	High Moderate
I enjoy myself in STEM subjects' class.	2 (3.1%)	3 (4.75 %)	10 (15.6%)	31 (48.4%)	18 (28.1%)	3.93	0.95	High Moderate
I like STEM subjects.	2 (3.1%)	5 (7.8%)	7 (10.9%)	32 (50%)	18 (28.1%)	3.92	0.99	High Moderate
I easily understand STEM subjects compared to others.	4 (6.3%)	9 (14.1 %)	14 (21.9%)	18 (28.1%)	19 (29.7%)	3.60	1.22	High Moderate
I often go ahead with problems on my own.	3 (4.75 %)	5 (7.8%)	7 (10.9%)	32 (50%)	17 (26.6%)	3.85	1.05	High Moderate
I understand STEM contents well in class.	3 (4.75 %)	5 (7.8%)	8 (12.5%)	32 (50%)	16 (25%)	3.82	1.04	High Moderate

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
I often discuss problems with others.	3 (4.75 %)	5 (7.8%)	5 (7.8%)	32 (50%)	19 (29.7%)	3.92	1.05	High Moderate
I often get homework done correctly.	3 (4.75 %)	5 (7.8%)	8 (12.5%)	32 (50%)	16 (25%)	3.82	1.04	High Moderate
I am very calm when called on in class.	3 (4.75 %)	9 (14.1 %)	10 (15.6%)	26 (40.6%)	16 (25%)	3.67	1.14	High Moderate
I am confident in learning STEM subjects.	2 (3.1%)	8 (12.5 %)	7 (10.9%)	30 (46.9%)	17 (26.6%)	3.81	1.06	High Moderate
I am interested in STEM subjects.	1 (1.6%)	6 (9.4%)	7 (10.9%)	32 (50%)	18 (281%)	3.93	0.95	High Moderate
I do not worry about STEM-related tests.	8 (12.5 %)	12 (18.8 %)	12 (18.8%)	15 (23.4%)	(17) (26.6%)	3.32	1.38	High Moderate
I care a lot about learning STEM subjects.	2 (3.1%)	6 (9.4%)	6 (9.4%)	33 (51.6%)	17 (26.6%)	3.89	1.00	High Moderate
Role of self-concept						**3.77**	**0.86**	**High Moderate**

The descriptive analysis indicates that overall role of self-concept is at a moderately high level with a mean value of 3.77 and a standard deviation of 0.86. The item with the highest mean value is "I often submit homework on time" with a mean value of 4.06 and a standard deviation of 0.94, placing it at a high level. Based on these findings, 21 individuals or 32.8% expressed "Strongly Agree." However, 2 individuals or 3.1% strongly disagreed. Meanwhile, the item with the lowest mean value is “I do not worry about STEM-related tests" with a mean value of 3.32 and a standard deviation of 1.38, at a moderately high level. Based on these findings, 8 individuals or 12.5% strongly disagreed. However, 17 individuals or 26.6% strongly agreed.

Table 9. Self-Efficacy

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
get good grades in your STEM courses this semester?	1 (1.6%)	6 (9.4%)	13 (20.3%)	30 (46.9%)	14 (21.9%)	3.78	0.95	High Moderate
get help with assignments or study if needed?	2 (3.1%)	3 (4.7%)	8 (12.5%)	34 (53.1%)	17 (26.6%)	3.95	0.93	High Moderate
get needed accommodation necessary for full participation in courses?	2 (3.1%)	2 (3.1%)	10 (15.6%)	32 (50%)	18 (28.1%)	3.96	0.92	High Moderate
do well in your STEM classes as other students?	1 (1.6%)	6 (9.4%)	15 (23.4%)	27 (42.2%)	15 (23.4%)	3.76	0.97	High Moderate
persist in your STEM courses	2 (3.1%)	5 (7.8%)	6 (9.4%)	35 (54.7%)	16 (25%)	3.90	0.97	High Moderate

Item	SD	D	U	A	SA	Mean	Standard Deviation	Interpretation
even when faced with criticism?								
remain calm and relaxed during tests?	3 (4.7%)	11 (17.2%)	8 (12.5%)	27 (42.2%)	16 (25%)	3.68	1.12	High Moderate
remain calm and relaxed when expected to complete a challenging assignment?	3 (4.7%)	7 (10.9%)	5 (7.8%)	30 (46.9%)	20 (31.3%)	3.92	1.05	High Moderate
Self-Efficacy						**3.85**	**0.87**	**High Moderate**

The descriptive analysis indicates that overall self-efficacy is at a moderately high level with a mean value of 3.85 and a standard deviation of 0.87. The item with the highest mean value is "get needed accommodation necessary for full participation in courses?" with a mean value of 3.96 and a standard deviation of 0.92, placing it at a moderately high level. Notably, 18 individuals or 28.1% expressed "Strongly Agree", while only 2 individuals or 3.1% strongly disagreed. Conversely, the item with the lowest mean value is “remain calm and relaxed during tests" with a mean value of 3.68 and a standard deviation of 1.12, also at a moderately high level. Surprisingly, 2 individuals or 3.1% strongly disagreed while 16 individuals or 25% strongly agreed with this statement.

The Differences in Psychological Construction Based on Interests

Research Objectives 2: To identify the differences of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy based on interests.

Ho1: There are no differences of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy based on interests.

The comparison of psychological construction based on interests was conducted using a One-Way MANOVA. Before conducting the MANOVA analysis, the researchers ensured and confirmed that the data were normally distributed and homogenous. To verify the normal distribution of the data, the researchers conducted a normality test as presented in the following table.

Table 10. Normality Test

Psychological Construction	Skewness		Kurtosis	
	Value	SE	Value	SE
Identity	-0.422	0.299	-0.581	0.590
Interests	-0.624	0.299	0.135	0.590
Role of Self-Concept	-0.625	0.299	0.553	0.590
Self-Efficacy	-0.929	0.299	1.368	0.590

Based on Table 10, all aspects are normally distributed with Skewness and Kurtosis values within the range of ± 1.96. Before conducting the One-Way MANOVA analysis, the researchers first assessed the homogeneity of covariance matrices using Levene's test. This Levene's test is crucial to determine whether the covariance variance among the dependent variables is equal or not across all levels of the independent variables. This is an important prerequisite for the MANOVA test. The following Table shows the results of the Levene's test.

Table 11. Levene Test

Psychological Construction	Levene	Df1	Df2	Sig.
Identity	0.336	1	62	0.564
Interests	0.477	1	62	0.493
Role of Self-Concept	1.521	1	62	0.222
Self-Efficacy	1.739	1	62	0.192

Based on Table 11, significant differences in covariance variances were found among the dependent variables for the aspects of identity (Levene=0.336, p=0.564), interests (Levene=0.477, p=0.493), role of self-concept (Levene=1.521, p=0.222), and self-efficacy (Levene=1.739, p=0.192) (p>0.01). This indicates that the covariance variances of the dependent variables are homogeneous across all levels of the independent variables. The results of the One-Way MANOVA analysis are as follows.

Table 12. One Way MANOVA

Psychological Construction	Sum of Squares	df	Mean Squares	F	Sig.
Identity	0.231	1	0.231	0.355	0.554
Interests	0.000	1	0.000	0.001	0.980
Role of Self-Concept	0.087	1	0.087	0.115	0.736
Self-Efficacy	0.000	1	0.000	0.000	0.986

Based on Table 12, the study findings indicate that there are no significant differences in psychological construction for the aspects of identity (F=0.355, sig=0.554), interests (F=0.001, 0.980), role of self-concept (F=0.115, p=0.736), and self-efficacy (F=0.000, 0.986) based on interests. Table 13 shows the mean scores and standard deviations for each variable based on interests.

Table 13. Mean Score and Standard Deviation

Psychological Construction	Interests	N	Mean	Std. Deviation
Identity	Arts	36	3.87	0.83
	Science	28	3.75	0.76
	Total	64	3.82	0.80
Interest	Arts	36	3.87	0.84
	Science	28	3.86	0.79
	Total	64	3.86	0.81
Role of Self-Concept	Arts	36	3.81	0.94
	Science	28	3.73	0.75
	Total	64	3.77	0.86
Self-Efficacy	Arts	36	3.85	0.99
	Science	28	3.85	0.70
	Total	64	3.85	0.87

Based on the results in Table 13, respondents with an interest in arts have higher scores in identity (M = 3.87), interests (M = 3.87), and role of self-concept (M = 3.81) compared to respondents with an interest in science.

The Relationship Between Variables in Psychological Construction

Research Objectives 3: To identify the relationship between variables in psychological construction.

Ho2: There is no relationship between variables in psychological construction.
To identify the relationship between variables in psychological construction, the researchers conducted Pearson Correlation analysis. Table 14 shows the results of the Pearson Correlation analysis.

Table 14. Pearson Correlation

		Identity	Interest	Role of Self-Concept	Self-Efficacy
Identity	Pearson Correlation	1	.879**	.818**	.842**
	Sig. (2-tailed)		.000	.000	.000
	N	64	64	64	64
Interest	Pearson Correlation	.879**	1	.858**	.908**
	Sig. (2-tailed)	.000		.000	.000
	N	64	64	64	64
Role of Self-Concept	Pearson Correlation	.818**	.858**	1	.891**
	Sig. (2-tailed)	.000	.000		.000
	N	64	64	64	64
Self-Efficacy	Pearson Correlation	.842**	.908**	.891**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	64	64	64	64

Based on Table 14, there is a significant relationship between identity and interests (r=0.879, p=0.000), the role of self-concept (r=0.818, p=0.000), and self-efficacy (r=0.842, p=0.000). Furthermore, a significant relationship was found between interests and the role of self-concept (r=0.858, p=0.000) and self-efficacy (r=0.908, p=0.000). Additionally, there is a relationship between the role of self-concept and self-efficacy (r=0.891, p=0.000). The strength of the relationships is very strong.

4. Discussion

The current study was undertaken to understand and examine the level of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy, to identify the differences of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy based on interests and to examine the relationship between variables in psychological construction. For this purpose, the effect of the four independent variables on female's intentions to pursue STEM fields were scrutinised. The variables comprised identity, interests, role of self-concepts and self-efficacy.

The results revealed that females' intention to pursue in STEM fields is at moderately high level and positively affects their identity. The results are in line with past studies. According to a study on fostering formation of STEM identity in an authentic setting, Singer et al. (2020) reported that authentic learning experiences constructed around notions of inclusion and diversity can assist students in increasing feelings of belonging and optimistic STEM identities. As stated beforehand, individual attitude regarding STEM influences involvement, interest (Heilbronner, 2013), and performance (Freeman et al., 2014).

Additionally, the results on female's intention to pursue in STEM fields shows that it is at moderately high level and positively affects their interest. According to Goreth and Vollmer (2023), female interest in STEM education is strongly mediated by their enrolment into degree programmes and technical socialisation. However, their results suggested that female interest in STEM education has no relationship with conscientiousness. In other words, female students who lack conscientiousness with good grades are additionally inclined towards selecting engineering as their major of study.

Furthermore, the results of the current study have revealed that female's intention to pursue STEM fields is at moderately high level and positively affects their role of self-concept. The one-way MANOVA analysis showed that there are no significant differences in psychological construction for the aspects of identity, interests, role of self-concept and self-efficacy. It reveals that females with an interest in arts have higher scores in identity, interests, and role of self-concept compared to females with an

interest in science. These findings suggest that the numerous aspects of identity do not indicate prominent variations in females' psychological composition. Factors such as identity, interest, the role of self-concept and self-efficacy or other aspects connected to how people view themselves. All psychological aspects yielded almost similar results.

Moreover, this current study reported that there is a relationship between the role of self-concept and self-efficacy towards female's intentions in pursuing STEM education. The strength of the relationships is very strong. A study by Brown et al. (2016) reported comparable results in considering the relationship between intention and self-efficacy of secondary school students. Another similar study was reported by Fouad and Santa (2017) mentioned that a student's intention to continue STEM self-concept will certainly influence female students' self-efficacy.

5. Conclusion and Implications

The current research aimed at investigating the level of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy among females and to examine the differences in psychological construction bases on interest. Additionally, the research sought to identity relationships between these psychological variables and their impact on females' intentions to pursue STEM fields.

All the three objectives were achieved, as described in the results and discussion sections of this article. The levels of psychological construction for aspects of identity, interest, the role of self-concept, and self-efficacy were investigated through a quantitative survey using SPSS version 22 and descriptive statistics. The results of the research carry important implications.

Results of the research had ample important implications. First, the findings indicate that identity, interest, the role of self-concept, and self-efficacy play an important role in fostering interest among females to pursue STEM education, thereby retaining young individual's interest in STEM in China. The issue extends beyond the marginalisation of females in STEM and should incorporate aspects related to the roles that females can exemplify and hold in STEM disciplines, specifically within the community and globally.

To address these issues, the government and policymakers must implement measures to promote long-term female involvement in STEM disciplines rather than focusing on short-term interventions. This approach will further bolster females' motivations and attitudes. Additional initiatives, in the form of policies, should be implemented to extend safe and equal opportunities for females to contribute to STEM-related professions.

Self-efficacy emerges as another important variable in the psychological aspect for females to continue STEM education. Thus, it is crucial for the government and policymakers to devise policies to enhance factors benefitting females and regulate those factors that may obstruct the STEM self-efficacy of China females, thereby inspiring more females to continue STEM education.

Some limitations have been identified in the current study. The data were collected from Cheng Gong districts in Yunnan province, China, limiting the generalisability of the results to the whole nation. The data were only gathered from 64 females and to increase the scope of future research, potential researchers can include more respondents from different provinces. Moreover, further variables should be investigated to comprehend other reasons or factors inhibiting females from pursuing STEM education.

6. Co-author Contribution

All the authors affirmed that there is no conflict of interest in this article. Author 1 carried out the conception and investigation. Author 2 prepared the relevant literature. Author 3 wrote the research design. Author 4 carried out the data entry analysis. Author 5 prepared the interpretation of the results. Author 6 contributed to drafting and revising the article.

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8. References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Huma Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-t

Antonius, R. (2003). *Interpreting Quantitative Data with SPSS*. Sage, London.

Aulck, L., Aras, R., Li, L., L'Heureux, C., Lu, P., and West, J. (2017). STEM-ming the Tide: Predicting STEM Attrition Using Student Transcript Data. In *Proceedings of Machine Learning for Education (ML4Ed) Workshop at ACM*

AAUW. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. Hill, C., Corbett, C., & Rose, A. Washington, DC: Author. www.aauw.org/research

Balta, N., Japashov, N., Karimova, A., Agaidarova, S., Abisheva, S., & Potvin P (2023) Middle and high school girls' attitude to science, technology, engineering, and mathematics career interest across grade levels and school types. *Front. Educ.* 8:1158041. https://doi.org/10.3389/feduc.2023.1158041

Baliyan, S. P. & Mokoena, S. (2024). Students' Choice Management: Recipe for Improving Enrollment in Private Higher Education Institution. *Asian Journal of University Education, 20*(10), 206-220.

Beier, M. E., Kim, M. H., Saterbak, A., Leautaud, V., Bishnoi, S., & Gilberto, J. M. (2019). The effect of authentic project-based learning on attitudes and career aspirations in STEM. *Journal of Research in Science Teaching, 56*(1), 3–23.

Bernard, R. E., & Cooperdock, E. H. (2018). No progress on diversity in 40 years. *Nature Geoscience, 11*(5), 292.

Bosnjak M, Ajzen I, & Schmidt P. (2020, Aug 31). The Theory of Planned Behavior: Selected Recent Advances and Applications. *Eur J Psychol., 16*(3):352-356. doi: 10.5964/ejop.v16i3.3107

Brenøe, A. A., &; Zölitz, U. (2020). Exposure to more female peers widens the gender gap in stem participation. *Journal of Labor Economics, 38*(4), 1009–1054

Brown, B. A., Henderson, J. B., Gray, S., Donovan, B., Sullivan, S., Patterson, A., et al. (2016). From Description to Explanation: An Empirical Exploration of the African-American Pipeline Problem in STEM. *J. Res. Sci. Teach. 53* (1), 146–177. https://doi.org/10.1002/tea.21249

Cundiff, J. L., Vescio, T. K., Loken, E., & Lo, L. (2013). Do gender–science stereotypes predict science identification and science career aspirations among undergraduate science majors? *Social Psychology of Education, 16*(4), 541-554. https://doi.org/10.1007/s11218-013-9232-8

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin, 143(*1).

Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *Proc. Natl. Acad. Sci. U.S.A. 113*, 8664–8668. https://doi.org/10.1073/pnas.1608207113

Fouad, N. A., & Santana, M. C. (2017). SCCT and Underrepresented Populations in STEM Fields: Moving the Needle. *Journal of Career Assessment, 25*(1), 24-39. https://doi.org/10.1177/1069072716658324

Honey, M., Pearson, G., & Schweingruber, H. (Eds). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research*. National Academies Press. https://doi.org/10.17226/18612

Johnson, D. R. (2012). Campus racial climate perceptions and overall sense of belonging among racially diverse women in STEM majors. *Journal of College Student Development, 53*(2), 336–346.

Prieto-Rodriguez, E., Sincock, K., & Berretta, R. (2022). A study of factors affecting women's lived experiences in STEM. *Humanit Soc Sci Commun 9*, 121. https://doi.org/10.1057/s41599-022-01136-1

Ertl, B., Luttenberger, S., & Paechter, M. (2017). The impact of gender stereotypes on the self-concept of female students in STEM subjects with an under-representation of females. *Frontiers in Psychology, 8*, 703. https://doi.org/10.3389/fpsyg.2017.00703

Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention and behavior: An introduction to theory and research. Addison-Wiley. https://doi.org/10.2307/2065853

Garriott, P. O., Hultgren, K. M., & Frazier, J. (2017). STEM stereotypes and high school students' math/science career goals. *Journal of Career Assessment, 25*(4), 585-600. https://doi.org/10.1177/1069072716665825

Guo, J., Marsh, H. W., Parker, P. D., Dicke, T., & Van Zanden, B. (2019). Countries, parental occupation, and girls' interest in science. *The Lancet, 393*(10171), e6–e8

Graves, Olga. (2014). Indicators for the Number of Females Choosing STEM Majors. (2014). *Senior Honors Projects*. 34.

Heilbronner, N. N. (2013). The STEM Pathway for Women: What Has Changed? *Gifted Child Quarterly, 57*(1), 39-55. https://doi.org/10.1177/0016986212460085

Jackson D., & Wilton N. (2017). Perceived employability among undergraduates and the importance of career self-management, work experience and individual characteristics. *Higher Journal of Educational Resource Development, 36*, 747–762. https://doi.org/10.1080/07294360.2016.1229270

Jain. J., Lee, Y. L., & Mok, S. J. (2023). A Systematic Review of Pedagogical Content Knowledge for Teaching Nature of Science. *Asian Journal of University Education, 20*(1), 138-151.

Kiernan, L., Walsh, M., & Whitem Eoin. (2023). Gender in Technology, Engineering and Design: factors which influence low STEM subject uptake among females at third level. *International Journal of Technology and Design Education, 33*:497–520.

Kuchynka, S., Reifsteck, T. V., Gates, A., E., & Rivera. L. M. (2021) Developing Self-Efficacy and Behavioral Intentions Among Underrepresented Students in STEM: The Role of Active Learning. *Frontiers in Education. 6*:668239. https://doi.org/10.3389/feduc.2021.668239

Law F, McGuire L, Winterbottom M & Rutland A. (2021). Children's Gender Stereotypes in STEM Following a One-Shot Growth Mindset Intervention in a Science Museum. *Frontiers in Psychology, 12*, 641-695. https://doi.org/10.3389/fpsyg.2021.641695

Lee, S., & Song, M. (2018). The socioeconomic ceiling and perceived employability in higher education: evidence from South Korea. *Korean Journal of Youth Studies, 25*, 231–258. https://doi.org/10.21509/KJYS.2018.11.25.11.231

Lent, R. W., & Brown, S. D. (2019). Social cognitive career theory at 25: Empirical status of the interest, choice, and performance models. *Journal of Vocational Behavior, 115*, Article 103316. https://doi.org/10.1016/j.jvb.2019.06.004

Liu, F. F., & Yan, W. K. (2021). College students' personal struggle and subjective well-being: the mediating role of social expectations. *Journal of Shijiazhuang University* (3), 138–142. https://doi.org/10.13573/j.cnki.sjzxyxb.2021.03.021

Liu X, Ji X, Zhang Y. (2023). Trajectories of college students' general self-efficacy, the related predictors, and depression: A piecewise growth mixture modeling approach. *Heliyon 25*; *9*(5): e15750. https://doi.org/10.1016/j.heliyon. 2023.e15750

National Research Council. (2013). *Monitoring Progress Toward Successful K-12 STEM Education: A Nation Advancing?* Washington, DC: The National Academies Press. https://doi.org/10.17226/13509.

Makarova E, Aeschlimann, B., & Herzog W (2019). The Gender Gap in STEM Fields: The Impact of the Gender Stereotype of Math and Science on Secondary Students' Career Aspirations. *Frontiers in Education, 4*,60. https://doi.org/10.3389/feduc.2019.00060

Macher D., Papousek I., Ruggeri K., & Paechter M. (2015). Statistics anxiety and performance: blessings in disguise. *Front.iers in Psychol.ogy, 6*:1116. 10.3389/fpsyg.2015.01116

Master, A., Cheryan, S., Moscatelli, A., & Meltzoff, A. N. (2017a). Programming experience promotes higher STEM motivation among first-grade girls. *J. Exp.Child Psychol. 160*, 92–106. https://doi.org/10.1016/j.jecp.2017.03.013

Martinez, A., & Christnacht, C. (2021). Women making gains in STEM occupations but still underrepresented. United States Census Bureau. https://www.census.gov/library/stories/2021/01/women-making-gains-in stem-occupations-but-still-underrepresented.

McGuire, L., Mulvey, K. L., Goff, E., Irvin, M. J., Winterbottom, M., Fields, G. E., Hartstone Rose, A., & Rutland, A. (2020). STEM gender stereotypes from early childhood through adolescence at informal science centers. *Journal of Applied Developmental*

Psychology, 67, 101-109. https://doi.org/10.1016/j.appdev.2020.101109
McNeill, F., & Wei, L. (2023). Encouraging Young Women into STEM Careers: A Study Comparing Career Intention of Female STEM Students in China and Scotland. *Journal for STEM Educational Resources.* https://doi.org/10.1007/s41979-023-00114-9
OECD (2015), "What Lies Behind Gender Inequality in Education?", PISA in Focus, No. 49, OECD Publishing, Paris. http://dx.doi.org/10.1787/5js4xffhhc30-en
Pajares, F. (2004). Gender differences in mathematics self-efficacy beliefs. In A. M. Gallagher & J. C. Kaufman (Eds.), *Gender differences in mathematics: An integrative psychological approach* (pp.294-315). Cambridge University Press. https://doi.org/10.1017/cbo9780511614446.015
Peng, H. (2022). Gender Differences in STEM Education in China. 2365-2373. Atlantis Press.
Qiao, Y. (2021). *Chinese Female Students and the STEM Gender Gap: How Stereotype Threat and Expectancy Value Shape Performance and Engagement*. Electronic Theses and Dissertations. 8629. https://scholar.uwindsor.ca/etd/8629
Rajenderan, M., &; Zawawi, D. (2019). Leaky pipeline syndrome in information and communication technology (ICT) industry of Malaysia: A conceptual study on female career barriers and retention management. *International Journal of Academic Research in Business and Social Sciences, 9*(2), 1158-1174.
Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International Journal of STEM Education, 5*(1), 10.
Ramsey, C. M. (2018). *STEM stories for STEM interest and identity for girls: A classroom-tested framework and prototype* [Doctoral dissertation, The University of Texas at Austin]. https://repositories.lib.utexas.edu/handle/2152/72750
Rittmayer, A. D., & Beier, M. E. (2008). Overview: Self-efficacy in STEM. *SWE-AWE CASEE Overviews*, 1-12.
Singer, A., Montgomery, G., & Schmoll, S. (2020). How to foster the formation of STEM identity: studying diversity in an authentic learning environment. *IJ STEM Ed 7,* 57 https://doi.org/10.1186/s40594-020-00254-z
Teoh, S. H., Siti Rosiah Mohamed, Boon, J., Z. H., Mohd Rustam Mohd Rameli, Najua Syuhada Ahmad Alhassora & Adjah Naqkiah Mazlan. (2024). Navigating Mathematical Challenges: Enhancing Mathematical Buoyancy among Rural Students for Tertiary-Level Preparedness. *Asian Journal of University Education, 20*(1), 138-151.
Turner, S. L., Joeng, J. R., Sims, M. D., Dade, S. N., & Reid, M. F. (2019). SES, gender, and STEM career interests, goals, and actions: A test of SCCT. *Journal of Career Assessment, 27,* 134–150. doi: 10.1177/1069072717748665
Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., & Behling, S. (2020). Active Learning narrows Achievement Gaps for Underrepresented Students in Undergraduate Science, Technology, Engineering, and Math. *Proc. Natl. Acad. Sci. U S A. 117* (12), 6476–6483. doi:10.1073/pnas.1916903117
Vondracek, F.W., Porfeli, E.J. (2008). Social Contexts for Career Guidance Throughout the World. Developmental-Contextual Perspectives on Career Across the Lifespan. In: J. A. Athanasou, & R. Van Esbroeck. (Eds.), *International Handbook of Career Guidance*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6230-8_10
Wang, M. T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review, 33*(4), 304–340 https://doi.org/10.1016/j.dr.2013.08.001.
Wen, W., Zhou, L., Hu, D., Zhang, M., Yan, Z., & Tang, X. (2023) The impact of college experience on female students' self-perceived employability in STEM majors. *Frontiers in Psychology, 14*:1282934. https://doi.org/10.3389/fpsyg.2023.1282934
Yin-Wang. (2019). *Chinese Urban Reform: What model now?* Routledge.

Zhong, B., Liu, X., & Zhan, Z. (2022). What should a Chinese top-level design in STEM Education looks like? *Journal of Humanities Social Sciences Communication, 9*, 261. https://doi.org/10.1057/s41599-022-01279-1