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# Student Attitudes and Interests in STEM in Qatar through the Lens of the Social Cognitive Theory

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**Abstract:** STEM (science, technology, engineering, and math) has taken center stage as a priority policy agenda for Qatar's leadership. At present, STEM stands as a fundamental catalyst for Qatar's sustainable economic, environmental, human, and social development goals, as is outlined in the Qatar National Vision 2030. The aim of this exploratory study was to investigate the determinants of students' interest in pursuing Science, Technology, Engineering, and Mathematics (STEM) studies and eventual careers in Qatar. This study used a survey involving a representative sample of a total of 425 students from public (government-funded) middle schools in the country. Data for this research were gathered using a survey distributed to students in grades 7, 8, and 9. Guided by the Social Cognitive Theory, a survey was implemented with a view to investigating the intrinsic and extrinsic factors likely to contribute to student STEM educational and career interest. Two main statistical tests were carried out: independent sample *t*-tests and one way ANOVA. Results derived from the study reveal that gender, nationality, and parental education and occupation served as predictors of student interest in a STEM degree or profession. The results derived from this study have important implications for STEM-related fields of study and career.

**Keywords:** STEM interest; sustainability; education; careers; social cognitive career theory; Qatar

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## 1. Introduction

Over the past few decades, science, technology, engineering, and mathematics (STEM) has gained prominence as a field of study and research. Exploring STEM disciplines has been identified as a particularly important area in the realms of education, industry, innovation, and policymaking. Indeed, in the light of many of the pressing economic, environment, and health ailments the world is facing, the demand for professionals with STEM skill sets that help to address real-world problems will continue to prevail locally as well as internationally. In parallel, education systems are increasingly required to prepare students in STEM-related fields of study and future jobs in order to bolster a nation's sustainable economic and social well-being [1].

STEM education has become a strategic national priority in many countries across the globe. Demand for a highly educated workforce in STEM-related fields is increasingly turning into a pressing necessity to national development and prosperity, economic growth and competitiveness, and societal well-being [2,3]. In the context of Qatar, the recognition of the importance of the skills viewed as critical for developing a knowledgeable and qualified workforce drove the leadership to make significant investments in STEM education and research. At the core of efforts aiming to develop high-quality STEM education programs is the need to enhance student interest and motivation to pursue and engage in STEM disciplines and professions [4,5].

While a sizeable body of STEM literature has focused on Western, mainly North American, European, and Australian contexts, less work is performed on students' attitudes and interests in STEM in the Middle East and North Africa (MENA) region. Much less is known about the enabling factors or barriers that influence student interest and engagement towards pursuing STEM degrees and careers paths. Also lacking are studies seeking to explore methods and means of recruiting and engaging more students in STEM areas, especially in the Gulf Cooperation Council states such as Qatar. At all levels of pre-college and post-secondary levels of education, published research on STEM in Qatar is limited [6–14].

The purpose of the current study was to identify the factors affecting students' interest and participation in a STEM field of study and an eventual career in Qatar. Interest in this topic was sparked by the growing concerns about the dearth of qualified workers in the context of Qatar, a situation that mirrors that of many other world regions. Similarly, our interest in the topic stemmed also from noticing that scholarship on STEM-related fields of study and careers is rather limited. There is, therefore, a need to explore the dynamics surrounding how to better promote STEM disciplines and careers. This would have to also take into consideration the influences that spark or dissuade student interest in STEM.

An important contribution that this study has for policymaking and scholarly knowledge lies in its emphasis on the importance of fostering young Qataris' interest in STEM and the value of STEM teaching and learning for sustainable development in Qatar. If Qatar's education system is to produce a national workforce that is equipped with the critical skills required to meet the needs of today's competitive environments, it is vital to promote students' STEM educational and career pathways at various education levels. A starting point in this direction would be to ensure students are interested and engaged in studying STEM.

The next section reviews the extant literature that has addressed STEM fields of study and careers and examines the theoretical model guiding our study, namely, the Social Cognitive Theory. The section that follows provides a detailed description of the research design and research methods utilized in our study, including sampling, instrumentation, data collection, and analysis procedures. The paper proceeds to present the study's results, followed by the discussion of its key findings, and concludes with policy recommendations.

### *1.1. Context of the Study: Education, STEM and Qatar's National Vision (QNV) 2030*

The State of Qatar is a small rentier country that enjoys abundant wealth from gas and oil resources. Seeking to develop a competitive and diversified economy has been a top priority on the policy agendas of the country's leadership for the past few decades [15]. An essential component of Qatar's development plans outlined in the National Vision 2030 is the economic pillar, underscoring the urgency of diversifying and securing a sustainable economy [16]. The achievement of this goal hinges on the country's strategic decision to transform its economy from a heavy reliance on natural resources to a knowledge-based economy optimizing its intellectual assets.

With its unique demographic profile, Qatar is striving to transition into a knowledge-based society. To attain this goal, it is crucial that the country's policy endeavors aim to develop citizens' knowledge, skills, and competencies in STEM, as is emphasized in Qatar's National Vision 2030. Despite repeated efforts and the significant resources channeled by Qatar's governments to overhaul the education system, concerns are voiced regarding the shortage of citizens who possess the knowledge, skills, and competencies required for the transition to the knowledge economy. For example, official national reports have documented the alarming issue of low student enrollment in science, mathematics, and technology among Qataris in higher education [17–19]. Exacerbating the situation is Qatar's poor performance in mathematics and science on national and international tests such as PISA and TIMSS [20,21].

### *1.2. Literature Review*

Looking at the extant literature reveals that STEM has attracted a significant volume of attention in educational, economic, and political arenas [22,23]. The bulk of available research demonstrates an evident lack of consensus among scholars regarding how STEM is conceptualized and/or theorized. Depending on the lens used and the perspective adopted, researchers have used the term STEM in various ways, ascribing different meanings to the concept [24,25], including as a combination of individual disciplines or an interdisciplinary field of study and research. Further, the different extensions and variations of the term—STEM, STEMM (including medicine), or STEAM (including arts) [26,27]—have led to multiple understandings of "STEM".

Johnson, Mohr-Schroeder, and Moore [28] note that the bulk of literature that has investigated topics related to STEM education has increased significantly, thus calling for future research studies. An area that has garnered growing attention in the sphere of STEM education and is consistently echoed in public and private discourse is connected with students' attitudes towards and interest in STEM disciplines and potential professions [29–31]. Past and recent studies' endeavors have, over the past few decades, broadened our understanding of the reasons that enable or inhibit students' entrance into and persistence in STEM studies and professions [32–35].

Documented research reports an assortment of factors that encourage and promote students' interest and motivation to pursue STEM educational and career pathways [36–40]. Other research, however, cites a host of reasons that thwart students' entrance into and persistence in STEM fields and their interest in STEM degrees or professions [36,41–44]. Given the scope of this paper, we will not delve into the barriers that deter children's interest in STEM. Instead, our focus will be solely on the factors that facilitate STEM interest.

We drew on the Self-Determination Theory and propose two distinct types of motivation that are relevant to our study: intrinsic motivation and extrinsic motivation. In line with the aim of this study, intrinsic motivation prompts students to engage in mathematics, science, and technology due to their personal interest in and enjoyment of learning these subjects. Intrinsic factors encompass student attributes, including demographic characteristics (e.g., gender, nationality, familial background), ability, attitude, engagement, interest, and self-efficacy [45,46].

By contrast, extrinsic motivation instigates student engagement in learning for external reasons. Extrinsic motivation comprises the perceived utility of mathematics, science, and technology for potential career paths [47], the expectations of parents and other important role models [48,49], and the desire to achieve good grades [50]. Other examples of extrinsic motivation comprise the quality of teaching, and stereotyping of scientists [51], to mention a few.

Research undertaken by [52–54] lends evidence showing that students form their attitudes toward mathematics and science early in life and long before they attend college. For example, middle school years are especially crucial because this period sets the stage for students to plan their career development and choice decisions in various fields based on their attitude and interest in those fields [55,56]. Beyond schooling, STEM interest impacts student aspiration to related careers in the future [52,53].

An important feature dominating discussions of interest and participation in STEM is the issue of gender disparities in the areas related to STEM educational pathways [42,46]. Indeed, various factors have been identified as contributing to the underrepresentation of women in STEM [49,57,58]. In many societies, this remains an issue that continues to exacerbate their low participation in STEM-related areas, causing an alarming leaky pipeline [59].

The literature on gender-based differences in STEM suggests an ongoing debate about the reasons lying behind the male–female gap in the field. The sources of gender variations in STEM have been ascribed to a wide range of micro- and macro-level factors. Micro-level explanations reported in the available research comprise a person's cognitive attributes (critical thinking, logical reasoning, problem solving, etc.) [30,60] and non-cognitive factors (e.g., attitudes, engagement, interest, self-efficacy, perceived benefits, institution-related factors, etc.) [61–63].

### *1.3. Theoretical Framework: Social Cognitive Theory (SCT)*

The present research is anchored on the Social Cognitive Theory (SCT) [64,65] as a theoretical framework that provides a lens for studying the influences shaping students' attitudes and interests in STEM degrees and professions. The SCT helps to understand the factors impacting people's cognitive processes, including their attitudes, judgments, and motivations and how these latter, in turn, affect their behavior. The theory posits that learning takes place in an environment where one learns through observing the behavior of others. Drawing on the SCT as a theoretical construct, this study underscores interrelationships among the factors affecting perceptions of educational and professional STEM interests; it asserts that STEM-related attitudes and interests are driven by personal (individual) and environmental (school-related) factors.

### *1.4. Aims and Problems of the Study*

As Qatar strives to transition to a knowledge-based society, a prime challenge it faces is the shortage of skilled labor in STEM domains, which is identified as crucial to the country's economy and well-being. To address the lack of national skills and talents in STEM, Qatar's successive governments have been compelled to import highly skilled professionals from overseas while also launching education reform initiatives that place emphasis on STEM as critical assets for Qatar's sustainable economic success [4]. However, despite the concerted efforts and the resources dedicated by Qatar to revamp education, a persistent challenge consists of the performance of Qatari students in mathematics and science on national and international tests, e.g., PISA and TIMSS, which remains poor.

In this present research, we hypothesized that students' individual attributes and contextual (household) factors influence student interest in STEM studies and future careers in Qatar. The research questions that guided this study are as follows:

1. What are the influences that drive students' attitudes and interests in pursuing mathematics, science, and technology as school subjects?
2. How do students' attitudes and interests vary based on their demographic characteristics?

## 2. Materials and Methods

### *2.1. Design and Instrumentation*

The purpose of this exploratory study was to investigate the determinants of student attitudes and interests in STEM fields of study in public middle schools in Qatar. Building on the SCT, the researchers developed the student attitudes/interests survey. In developing the survey for our study, we conducted a review of the relevant literature on STEM and the instruments that assess student attitudes toward STEM, thus adopting an approach to scale development that is widely used [66]. Additionally, we drew on the Upper Elementary School and Middle/High School Student Attitudes toward STEM (S-STEM) Survey developed by a group of researchers based at The Friday Institute for Educational Innovation, North Carolina State University [67]. The S-STEM Survey measures student attitudes toward science, mathematics, engineering, and technology using Likert-scale items and 21st century skills.

The instrument was first designed in English and then translated into Arabic, followed by the translation of the Arabic version back to English. All translations were performed and checked by English–Arabic translation faculty members at Qatar University and Hamad Bin Khalifa University in Qatar.

### *2.2. Participants*

The study involved 425 Qatari and non-Qatari students enrolled in seven public preparatory schools across Qatar. Preparatory school students in 7th (30.2%), 8th (33.6%), and 9th (36.3%) grades took part in the survey.

### 2.3. Sampling

In sampling students for our study, we used a two-stage stratified sampling technique. Firstly, we stratified schools based on Qatar's school system (public schools), gender (boy, girl, or co-ed), and grade level (7th, 8th, and 9th grades). The schools were chosen with a probability proportionate to their size to allow students an equal chance of being selected. This permitted the selection of similar numbers of students from each of the schools chosen for each stratum. Accordingly, we randomly chose one class of students representing each of the three grade levels in the selected school and all students in the class participated in the survey. In total, 425 students from public middle schools were sampled for our study.

### 2.4. Data Collection and Procedure

Data for the study were collected using an online survey questionnaire disseminated to preparatory school students. The data were collected from 4 male and 3 female preparatory government schools from different municipalities in Qatar during the Fall Semester of the 2022/2023 school year.

As a first step in conducting the study, the required approvals were obtained from the Ministry of Education in Qatar November 2021 and Qatar University's Internal Review Board (IRB) in June 2022. Letters were then sent to the schools selected for the survey, requesting permission to allocate a suitable 30 min time slot during a school day for students to complete the questionnaire. Prior to the survey, students were given consent forms to complete, stating the aim of the study and clarifying that their participation was optional. They were also assured their identity would not be revealed and that the information they provide would be confidential. In September 2022, parental permission forms were sent to parents, explaining the research purpose and ensuring them that their child's participation would be confidential.

Individual (Personal) Factors: Gender and Nationality

*Gender*. This was used in the analysis as a dichotomous variable, where male = 0 and female = 1.

*Nationality*. In the questionnaire, students were asked to specify their nationality (Qatari or non-Qatari).

*Contextual (Household) factors*. The father's/mother's level of education and status of employment were examined as household predictors of student attitudes and interests.

*Father's/Mother's education*. Students were required to choose from the following: (1) Primary; (2) Preparatory; (3) Secondary; (4) Post-secondary (Diploma); (5) University Graduate or Bachelor's degree; (6) Masters' degree; (7) Ph.D.; and (8) Never attended any school.

*Father's/Mother's employment*. Students were asked two questions, one for the father and another for the mother: "What is your father's (OR: mother's) main occupation?" They were then asked to choose from the following options: (1) full-time employee; (2) part-time employee; (3) retired; (4) unemployed, seeking a job; (5) unemployed, not seeking a job; (6) unable to work. In our analysis, these options were combined into 3 categories for fathers/mothers (Employed/Unemployed/Other) and 3 for mothers (Employed/Housewife/Other). The sample characteristics are presented in Table 1 below.

**Table 1.** Demographic Data.

| Variables | | N | % |
|---|---|---|---|
| Gender | Male | 172 | 38.1 |
| | Female | 279 | 61.9 |
| Nationality | Qatari | 216 | 47.9 |
| | Non-Qatari | 235 | 52.1 |

**Table 1.** *Cont.*

| Variables | | N | % |
|---|---|---|---|
| Father's level of Education | Never joined school<br>Elementary<br>Preparatory<br>Secondary | 188 | 41.7 |
| | Post-Secondary<br>Bachelor's degree<br>Master's degree<br>Ph.D. | 263 | 58.3 |
| Father's employment status | Full-time employee<br>Part-time employee | 395 | 90.4 |
| | Retired | 29 | 6.6 |
| | Unemployed, seeking a job<br>Unemployed, not seeking a job<br>Unable to work | 13 | 3 |
| Father's main occupation | Related to STEM | 102 | 31 |
| | Not related to STEM | 227 | 69 |
| Mother's level of Education | Never joined school<br>Elementary<br>Preparatory<br>Secondary | 194 | 43.9 |
| | Post-Secondary<br>Bachelor's degree<br>Master's<br>Ph.D. | 248 | 56.1 |
| Mother's employment status | Full-time employee<br>Part-time employee | 229 | 52.8 |
| | Retired | 17 | 3.9 |
| | Unemployed, seeking a job<br>Unemployed, not seeking a job<br>Unable to work | 188 | 43.3 |
| Mother's main occupation | Related to STEM | 38 | 19.8 |
| | Not related to STEM | 154 | 80.2 |
| Grade | Grade 7<br>Grade 8<br>Grade 9 | 133<br>148<br>160 | 30.2<br>33.6<br>36.3 |

### 2.5. Analysis

In our data analysis, version 29 of the Statistical Package for the Social Sciences (SPSS) was used. In addition to descriptive statistics, *t*-test and ANOVA were employed to examine relationships likely to hold between students' interest in mathematics, science, and technology and their demographic characteristics. Tables are provided below to illustrate the data. Mean scores and standard deviation of all measured items are reported. It needs to be stated that ANOVA analyses did not yield any significant results and, as a result, our focus in the following sections will be solely limited to results from *t*-test analyses. Demographic data are presented in Table 1 above.

## 3. Results

As we had three domains in the survey (interest in mathematics (IM), interest in science (IS), and interest in technology (IT)), we tested the average responses of each respondent for all items, and we considered these domains as dependent variables. Demographic data were considered as independent variables. *T*-tests were used to examine relationships between students' interest in mathematics, science, and technology and their demographic variables. More specifically, the aim was to compare and determine possible significant difference between the mean scores of two student groups for each of the following categories: gender, nationality, father's/mother's level of education, and father's/mother's occupation. Otherwise, we used the one-way ANOVA test to compare the mean scores of more than two groups of people in a (Grade) category.

As Table 2 demonstrates, independent sample *t*-test results revealed a statistically significant gender-based difference (t = 1.50, $p = 0.002$). Male students displayed higher interest in mathematics (M = 3.58, SD = 0.575) compared to females (M = 3.40, SD = 595). However, no significant difference was detected for males and females regarding interest in science (t = 1.50, $p = 0.133$) and technology (t = 0.777, $p = 0.437$).

**Table 2.** *T*-test of student interest in math, science, and technology compared with gender.

| Gender | | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Male | 164 | 3.5877 | 0.57511 | 3.083 | 427 | 0.002 |
| | Female | 265 | 3.4075 | 0.59567 | | | |
| IS | Male | 164 | 3.5282 | 0.63923 | 1.506 | 427 | 0.133 |
| | Female | 265 | 3.4363 | 0.59801 | | | |
| IT | Male | 164 | 3.5351 | 0.64953 | 0.777 | 427 | 0.437 |
| | Female | 265 | 3.4868 | 0.60923 | | | |

Figure 1 below illustrates the mean scores and standard deviation of variables by gender.

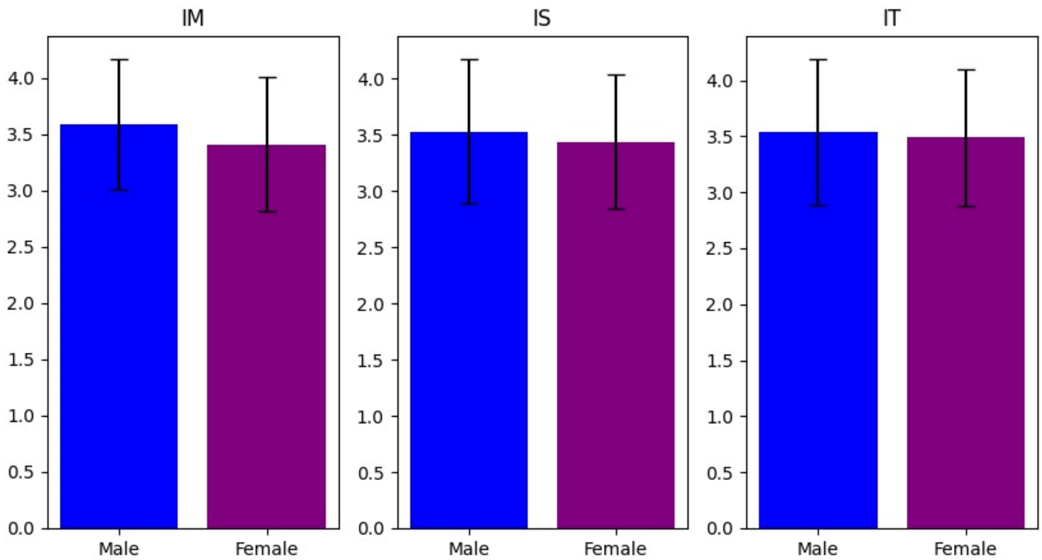


**Figure 1.** Mean and standard deviation of variables by gender.

Independent sample *t*-test results disclosed a statistically significant difference in students' nationality ($p < 0.05$), where non-Qatari students expressed higher interest in mathematics (M = 3.60, SD = 0.577), science (M = 3.55, SD = 0.623), and technology (M = 3.59, SD = 0.602) compared with Qataris (Table 3).

**Table 3.** *T*-test of student interest in math, science and technology compared with nationality.

| Nationality | | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Qatari | 206 | 3.3404 | 0.58195 | −4.669 | 427 | <0.001 |
| | Non-Qatari | 223 | 3.6020 | 0.57780 | | | |
| IS | Qatari | 206 | 3.3823 | 0.59388 | −2.911 | 427 | 0.002 |
| | Non-Qatari | 223 | 3.5538 | 0.62391 | | | |
| IT | Qatari | 206 | 3.4053 | 0.63413 | −3.219 | 427 | 0.001 |
| | Non-Qatari | 223 | 3.5975 | 0.60254 | | | |

Independent sample *t*-test indicated a significant difference in the father's level of education ($p < 0.05$). Students with a father holding a post-secondary degree or higher displayed higher interest in mathematics (M = 3.55, SD = 0.573), science (M = 3.54, SD = 0.624), and technology (M = 3.56, SD = 0.609) compared with students who have a father with a lower educational degree (Table 4).

**Table 4.** *T*-test of student interest in math, science and technology compared with fathers' level of education.

| Fathers' Level of Education | | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Never joined school/Elementary/Preparatory/Secondary | 178 | 3.3715 | 0.60751 | −3.113 | 427 | 0.002 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 251 | 3.5508 | 0.57340 | | | |
| IS | Never joined school/Elementary/Preparatory/Secondary | 178 | 3.3736 | 0.58900 | −2.797 | 427 | 0.005 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 251 | 3.5408 | 0.62466 | | | |
| IT | Never joined school/Elementary/Preparatory/Secondary | 178 | 3.4178 | 0.63697 | −2.455 | 427 | 0.014 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 251 | 3.5672 | 0.60943 | | | |

Independent sample *t*-test results reported a significant difference in the father's occupation ($p < 0.05$). Students with a father working in STEM-related fields showed higher interest in STEM subjects (mathematics (M = 3.62, SD = 0.564), science (M = 3.60, SD = 0.631), and technology (M = 3.66, SD = 0.637) compared with students having a father not working in fields related to STEM (Table 5).

**Table 5.** *T*-test of student interest in math, science and technology compared with fathers' main occupation.

| Fathers' Main Occupation | | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Related to STEM | 98 | 3.6250 | 0.56475 | 1.979 | 318 | 0.049 |
| | Not related to STEM | 222 | 3.4932 | 0.54176 | | | |
| IS | Related to STEM | 98 | 3.6033 | 0.63180 | 1.985 | 318 | 0.048 |
| | Not related to STEM | 222 | 3.4572 | 0.59587 | | | |

**Table 5.** *Cont.*

| | Fathers' Main Occupation | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IT | Related to STEM | 98 | 3.6633 | 0.63748 | 2.503 | 318 | 0.013 |
| | Not related to STEM | 222 | 3.4718 | 0.62736 | | | |

Independent sample *t*-test revealed a significant difference in the mother's level of education ($p < 0.05$) Students with a mother who completed post-secondary education and higher showed higher interest in STEM subjects (mathematics (M = 3.55, SD = 0.548), science (M = 3.53, SD = 0.607), and technology (M = 3.58, SD = 0.595)) compared to those having a mother with a lower educational degree Table 6).

**Table 6.** *T*-test of student interest in math, science and technology compared with mothers' level of education.

| | Mother's Level of Education | N | Mean | Std. Deviation | t | df | Double-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Never joined school/Elementary/Preparatory/Secondary | 185 | 3.38 | 0.637 | −3.048 | 427 | 0.002 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 244 | 3.55 | 0.548 | | | |
| IS | Never joined school/Elementary/Preparatory/Secondary | 185 | 3.3912 | 0.61658 | −2.365 | 427 | 0.018 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 244 | 3.5323 | 0.60799 | | | |
| IT | Never joined school/Elementary/Preparatory/Secondary | 185 | 3.4041 | 0.64841 | −2.948 | 427 | 0.003 |
| | Post-Secondary/Bachelor's/Master's/Ph.D. | 244 | 3.5820 | 0.59593 | | | |

Independent sample *t*-test indicated a statistically significant difference in the mother's occupation ($p < 0.05$). Students having a mother working in STEM-related fields exhibited higher interest in mathematics (M = 3.64, SD = 0.482) and technology (M = 3.78, SD = 0.492) compared to students with a mother not working in STEM areas (Table 7). However, no difference was detected for interest in science with respect to the mother's occupation.

**Table 7.** *T*-test of student interest in math, science and technology compared with mothers' main occupation.

| | Mothers' Main Occupation | N | Mean | Std. Deviation | t | df | Two-Sided *p* |
|---|---|---|---|---|---|---|---|
| IM | Related to STEM | 38 | 3.64 | 0.482 | 2.034 | 187 | 0.043 |
| | Not related to STEM | 151 | 3.43 | 0.589 | | | |
| IS | Related to STEM | 38 | 3.6184 | 0.53819 | 1.610 | 187 | 0.109 |
| | Not related to STEM | 151 | 3.4346 | 0.64965 | | | |
| IT | Related to STEM | 38 | 3.7862 | 0.49226 | 2.603 | 187 | 0.010 |
| | Not related to STEM | 151 | 3.5099 | 0.60528 | | | |

## 4. Discussion

This study explored student attitudes and interest in STEM, an area that is vital for building a sustainable knowledge-based society in Qatar. As was outlined in Qatar's Qatar

National Vision 2030, STEM is an important driver of the country's sustainable economic, environmental, human, and social development goals. The study's results presented above yield compelling evidence that individual (personal) and contextual (household) factors are important predictors of public school (7th, 8th, and 9th grades) student attitudes and interests in Qatar. The results support our hypothesis, showing a strong association between students' gender, nationality, and parental education level and profession, and their interest in pursuing STEM degrees and careers. These results were offset, however, by our expectations that the type of school that students attend, including the pedagogies and the curricula these school offer, will affect students' attitudes towards and perceptions of STEM.

### *4.1. What Are the Influences That Drive Students' Attitudes and Interests in Pursuing Mathematics, Science, and Technology as School Subjects?*

While our findings may be viewed as simply echoing previous research [68], we argue that the specific context of the present study offers insights and sound reasons why individual characteristics and parental attributes are determinant factors that shape children's interest in STEM degrees and future careers in the context under study.

In line with past studies [69,70], we contend that culture provides a frame of reference for contextualizing realities and experiences, and offers a lens through which to examine student perceptions of STEM degree and professions. For example, according to [71], culture furnishes a context in which parental expectations for their child's STEM performance are situated. It may, therefore, be useful to interpret our findings against the backlash of the local context of Qatar, including the composition of the student population, students' socio-cultural backgrounds, and characteristics of the educational system.

In their entirety, our findings may be interpreted in the context of how entitlements, which carry a culturally loaded significance in the Arabian Gulf region, are perceived in Qatar's society, much like other countries across the broader GCC region. Arguably, many barriers hamper social and economic development in this part of the world, including, "Expansive social safety nets, hide-bound cultural values, and government job perks [which] have blunted the potential impact of education" [72]. The authors assert that there are economic and societal divisions "between citizens and legions of resident expatriates (expats). Although citizens may be educated in a formal sense, many view education merely as a ticket to high paying, low-risk jobs with government-owned-and-operated businesses".

More recent research by [73] shows that the concept of entitlement in the GCC countries, entails "benefits that citizens have a right to by virtue of being natives of the country, rather than merit, i.e., 'earning' rewards people possess through effort, hard work and attainment". The researchers go on to argue that, "the riches of the GCC states have led to the creation of a rentier culture, which champions entitlements and nurtures unequal privileges" [73]. An immediate byproduct of entitlement is the decline of skilled local manpower by dissuading nationals from attending post-compulsory education and developing professional skills required for private sector jobs [74]. In turn, this has led to the erosion of students' interest in domains related to STEM, opting instead for the disciplines of arts, social sciences, literature, or religion, which are perceived as less challenging and less demanding subjects.

### *4.2. How Do Students' Attitudes and Interests Vary Based on Their Demographic Characteristics?*

The results from our study indicate that student gender and nationality, as well as parent education and occupation emerged as significant predictors of students' attitudes and interests in STEM-related degrees or professions. These factors help to explain the interaction between the background characteristics of students and their educational and career plans, and expand the literature base by offering an alternative Arabian Gulf perspective. Looking at nationality, for instance, our analysis yielded a statistically significant difference, with higher interest in mathematics, science, and technology among non-Qatari students compared with their Qatari counterparts.

The role of nationality as a predictor of STEM interest in the context of Qatar may be understood in the light of the unique demographic structure in the country, which is characterized by a population imbalance with a dominant presence of foreign-born residents compared to locals. Official statistics released recently by the Planning and Statistics Authority reveal that Qatari nationals make up around 12% of the country's total population of about 2.7 million (2,749,215 in July 2020) [75]. Our finding above corroborates results concluded in past research, which identified nationality as a key factor shaping student participation in STEM fields of study and professions, suggesting that nationals of the Gulf Cooperation Council (GCC) do not regard STEM as potential employment pathways in the future, while young expatriates do [8].

Qatar's school system reflects a similar story of the role of nationality in society, for as [72] point out, "As are all things in the GCC countries, society defines the form, shape, and substance of education; to date, the result has been that culture, language, and income sharply divide students". Public K–12 schools are attended mostly by nationals, as are the country's only two national universities, Qatar University and the University of Doha for Science and Technology established in 2022. Salient criticisms that have been reverberating in public and official discourse circles refer to the poor manner K–12 schools are managed and the jejune level of school graduates who find themselves unprepared for post-secondary education [72].

The results from our analysis also disclosed a statistically significant difference based on gender, with male students expressing higher interest in mathematics compared to females. Interestingly, no significant gender-related differences were observed regarding students' interest in science or technology. Research on gender-STEM disparities suggest rather inconsistent conclusions and often mixed results regarding the impact of gender on student interest in educational and professional pursuits in STEM fields. Several studies indicate that, relative to men, women are less likely to display interest in mathematics, mainly due to perceived lack of self-efficacy and anxiety [76], as well as low self-concept [77,78].

Another study conducted by Sadler and others [79] revealed that males tend to be drawn to fields such as engineering, while females are more inclined towards fields that involve the qualities of caring for others, including health, medicine, and nursing. Gender gaps in student STEM choices have also been ascribed to socio-cultural stereotypes, suggesting that males generally opt for science-oriented subjects while females are more likely to choose non-science subjects [80]. By contrast, other studies have found no significant gender-based differences in STEM-related student attitudes and interests [81]. For instance, recent score results from PISA and TIMSS reveal a decrease in the performance disparity between boys and girls and, in certain countries such as Finland, the latter outperformed their male counterparts [74]. These results echo findings from research by [82,83]. Similar other results emerged from an earlier study by [19], indicating that in Qatar, girls tend to exhibit positive attitudes towards and interest in STEM more than boys.

In this study, household characteristics, particularly parental education and occupation, were identified as important other predictors of students' interest in STEM. Students whose father or mother completed post-secondary education and higher tend to be more interested in pursuing a degree and eventually a career in mathematics, science, and technology in Qatar. These results are consistent with findings concluded from previous other studies [84,85]. Likewise, parental occupation appears to be a main predictor of student interest in mathematics, science, and technology; students with a parent working in a STEM-related field displayed greater interest in STEM, especially mathematics and technology, compared to students whose father or mother works in another field. These results further expand the findings concluded from work conducted by [86,87].

Combined, these results may be taken to signify the significance of the level of education and type of occupation of parents in shaping their child's attitude and interest in mathematics, science, and technology as school subjects. More specifically, positive associations have been detected between parental involvement and children's attitudes and interests in STEM, as a study conducted by [71] proposed. Indeed, there is ample evidence to suggest that parent involvement in the education of their child plays a key role in influencing the child's academic motivation [87], academic performance [68], attitude toward school [34], and self-efficacy [84]. The results above are better understood when looked at through the lens of the SCT, which helps to understand the individual and contextual influences that determine students' attitudes and interests in STEM.

## 5. Limitations

One of the limitations of this study concerns its examination of science, technology, (and engineering), and mathematics combined instead of exploring each independently. Treating the four disciplines together (STEM) as an integrated whole denies the variation that exists across different STEM domains and the wide differences. Demonstrably, STEM fields are different, with each having its distinct body of knowledge and its proper reservoir of functions and skills. Another limitation lies in the study's sole reliance on student data. Exploring the perspectives of parents and teachers will further enrich the analysis of additional data that examines intrinsic and extrinsic conditions affecting student choice to pursue or refrain from STEM. Future research is required to study in-depth, individual STEM disciplines and investigate, independently, STEM educational versus occupational student interests.

## 6. Conclusions

The aim of this study was to examine the factors that shape students' attitudes and drive their interests in pursuing studies and careers in domains related to STEM. Qatar's leadership identified STEM-related domains as critical to the country's sustainable development. The results presented above may be better understood using the Social Cognitive Theory and the Self-Determination Theory perspectives, which offer useful tools to understand the factors influencing student attitudes, interests, and motivations towards STEM studies and careers. In line with the SCT and the SDT, our study's findings suggest that context-related influences determine students' attitudes and interests in STEM fields of study and professions. In particular, students' individual characteristics (gender and nationality) and household factors (parental education and occupation) emerged as drivers of how the students viewed STEM.

To enhance nationals' representation in STEM fields in Qatar, increased attention is needed to focus on encouraging STEM interest. In consistency with the SCT, the results of our study revealed that students' interests are determined by individuals and their households. Additionally, looking at the likely influence of the school environment on student interests in STEM and non-STEM degrees, and future professions, will offer interesting insights into the different interest patterns of Qatar's different student populations. In addition, policy interventions targeting the development of student interest in STEM will need to explore (under)representation across the individual STEM fields, especially since representation, or lack of it, is not identical across these fields.

Against the backdrop of Qatar's National Vision 2030 and its emphasis on the importance of transforming the country to a knowledge-based economy, promoting STEM is of significance. Because STEM skill sets are critical to the country's sustainable development, work is needed to boost the recruitment and retention of residents, especially Qatari nationals, in STEM domains. While progress has been accomplished in terms of flourishing student enrollments, improved literacy rates, and women's access to education, these successes have not yet translated into a real, full-fledged transition to a knowledge economy.

By examining students' interest in pursuing STEM subjects and careers, this study provides an alternative perspective that increases our understanding of the topic and extends scholarly knowledge. Furthermore, it announces the need for educational policymaking to not only work on improving the quality of STEM teaching and learning, but also attract, recruit, and retain students to STEM from the early stages of schooling. This should be coupled with the importance of promoting STEM career pathways [72,73].

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## References

1. Mohr-Schroeder, M.J.; Bush, S.B.; Maiorca, C.; Nickels, M. Moving toward an equity-based approach for STEM literacy. In *Handbook of Research on STEM Education*; Routledge: Oxford, UK, 2020. [CrossRef]
2. Creel, B.; Nite, S.; Almarri, J.E.; Shafik, Z.; Mari, S.; Al-Thani, W.A. Inspiring interest in STEM education among Qatar's youth. In Proceedings of the 2017 ASEE International Forum, Columbus, OH, USA, 28 June 2017.
3. Freeman, B.; Marginson, S.; Tytler, R. An International View of Stem Education. In *STEM Education 2.0: Myths and Truths—What Has K-12 STEM Education Research Taught Us?* Brill: Leiden, The Netherlands, 2019. [CrossRef]
4. Barnett, C. *Human Capital and the Future of the Gulf*; District of Columbia: Center for Strategic and International Studies: Washington, DC, USA, 2015.
5. Weber, A.S. Linking Education to Creating a Knowledge Society: Qatar's Investment in the Education Sector. In *STEM Education: Concepts, Methodologies, Tools, and Applications*; IGI Global: Hershey, PA, USA, 2014. [CrossRef]
6. Abouhashem, A.; Abdou, R.; Bhadra, J.; Siby, N.; Ahmad, Z.; Al-Thani, N. COVID-19 Inspired a STEM-Based Virtual Learning Model for Middle Schools—A Case Study of Qatar. *Sustainability* **2021**, *13*, 2799. [CrossRef]
7. Said, Z.; El-Emadi, A.A.; Friesen, H.L. Teaching Style Differences between Male and Female Science Teachers in Qatari Schools: Possible Impact on Student Achievement. *Eurasia J. Math. Sci. Technol. Educ.* **2019**, *15*, em1800. [CrossRef]
8. Kayan-Fadlelmula, F.; Sellami, A.; Abdelkader, N.; Umer, S. A systematic review of STEM education research in the GCC countries: Trends, gaps and barriers. *Int. J. STEM Educ.* **2022**, *9*, 1–24. [CrossRef]
9. Fadlelmula, F.K.; Sellami, A.; Le, K. STEM learning during the COVID-19 pandemic in Qatar: Secondary school students' and teachers' perspectives. *Eurasia J. Math. Sci. Technol. Educ.* **2022**, *18*, em2123. [CrossRef] [PubMed]
10. Said, Z.; Al-Emadi, A.A.; Friesen, H.L.; Adam, E. Assessing the Science Interest, Attitude, and Self-Efficacy of Qatari Students at the Preparatory, Secondary, and University Levels. *Eurasia J. Math. Sci. Technol. Educ.* **2018**, *14*, em1618. [CrossRef]
11. Sellami, A.; Kimmel, L.; Wittrock, J.; Hunscher, B.; Cotter, A.; Al-Emadi, A.; Al-Emadi, D. Factors Shaping Qatari Students' Career Expectations in STEM, Business or Public Sector Fields. *Eurasia J. Math. Sci. Technol. Educ.* **2017**, *13*, 6491–6505. [CrossRef] [PubMed]
12. Sellami, A.; Fadlelmula, F.K.; Abdelkader, N.; Al Thani, M.F. A Critical Review of Research on STEM Education in Qatar. *Int. J. Humanit. Educ.* **2021**, *20*, 19–37. [CrossRef]
13. Sellami, A.; Ammar, M.; Ahmad, Z. Exploring Teachers' Perceptions of the Barriers to Teaching STEM in High Schools in Qatar. *Sustainability* **2022**, *14*, 15192. [CrossRef]
14. Charfeddine, L.; Barkat, K. *Do Oil and Gas Revenues Promote Economic Diversification in Qatar?* Qatar University: Doha, Qatar, 2020. [CrossRef]
15. Zguir, M.F.; Dubis, S.; Koç, M. Embedding Education for Sustainable Development (ESD) and SDGs values in curriculum: A comparative review on Qatar, Singapore and New Zealand. *J. Clean. Prod.* **2021**, *319*, 128534. [CrossRef]
16. Ben Hassen, T. The state of the knowledge-based economy in the Arab world: Cases of Qatar and Lebanon. *EuroMed J. Bus.* **2021**, *16*, 129–153. [CrossRef]
17. MacLeod, P.; Abou-El-Kheir, A. Qatar's English Education Policy in K-12 and Higher Education: Rapid Development, Radical Reform and Transition to a New Way Forward. In *Language Policy*; Springer: Berlin/Heidelberg, Germany, 2017. [CrossRef]
18. Sellami, A.; El-Kassem, R.C.; Al-Qassass, H.B.; Al-Rakeb, N.A. A Path Analysis of Student Interest in STEM, with Specific Reference to Qatari Students. *Eurasia J. Math. Sci. Technol. Educ.* **2017**, *13*, 6045–6067. [CrossRef]

19. Martin-Hansen, L. Examining ways to meaningfully support students in STEM. *Int. J. STEM Educ.* **2018**, *5*, 53. [CrossRef] [PubMed]
20. Mullis, I.V.S.; Martin, M.O.; Loveless, T. *20 Years of TIMSS International Trends in Mathematics and Science Achievement, Curriculum, and Instruction*; International Association for the Evaluation of Educational Achievement (IEA), UNESCO: Paris, France, 2016.
21. OECD (Organisation for Economic Co-Operation and Development), PISA 2018, OECD, Paris, 2019. PISA 2018 Results (Volume I): What Students Know and Can Do | PISA | OECD iLibrary. Available online: https://www.oecd-ilibrary.org/ (accessed on 4 March 2023).
22. Ritz, J.M.; Fan, S.-C. STEM and technology education: International state-of-the-art. *Int. J. Technol. Des. Educ.* **2015**, *25*, 429–451. [CrossRef]
23. Aguilera, D.; Lupiáñez, J.; Vílchez-González, J.; Perales-Palacios, F. In Search of a Long-Awaited Consensus on Disciplinary Integration in STEM Education. *Mathematics* **2021**, *9*, 597. [CrossRef]
24. Hinojo-Lucena, F.-J.; Dúo-Terrón, P.; Navas-Parejo, M.R.; Rodríguez-Jiménez, C.; Moreno-Guerrero, A.-J. Scientific Performance and Mapping of the Term STEM in Education on the Web of Science. *Sustainability* **2020**, *12*, 2279. [CrossRef]
25. Jeong, S.; Tippins, D.J.; Haverkos, K.; Kutner, M.; Kayumova, S.; Britton, S. *STEM Education and the Theft of Futures of Our Youth: Some Questions and Challenges for Educators*; Springer: Berlin/Heidelberg, Germany, 2019. [CrossRef]
26. Trevallion, D.; Trevallion, T. STEM: Design, Implement and Evaluate. *Int. J. Innov. Creat. Change* **2020**, *14*, 1–19.
27. Johnson, C.C.; Mohr-Schroeder, M.J.; Moore, T.J.; English, L.D. (Eds.) *Handbook of Research on STEM Education*; Routledge: London, UK, 2020. [CrossRef]
28. Bybee, R.W. *STEM Education Now More Than Ever*; National Science Teachers Association: Arlington, VA, USA, 2018.
29. Mcdonald, C.V. STEM Education: A Review of the Contribution of the Disciplines of Science, Technology, Engineering and Mathematics. *Sci. Educ. Int.* **2016**, *27*, 530–569.
30. Lee, M.-H.; Chai, C.S.; Hong, H.-Y. STEM Education in Asia Pacific: Challenges and Development. *Asia-Pac. Educ. Res.* **2019**, *28*, 1–4. [CrossRef]
31. Razali, F.; Talib, O.; Manaf, U.K.A.; Hassan, S.A. Students Attitude towards Science, Technology, Engineering and Mathematics in Developing Career Aspiration. *Int. J. Acad. Res. Bus. Soc. Sci.* **2018**, *8*, 946–960. [CrossRef]
32. Sahin, A.; Waxman, H.C. Factors Affecting High School Students' Stem Career Interest: Findings from a 4-Year Study. *J. STEM Educ.* **2021**, *22*, 5–19.
33. Tay, J.; Salazar, A.; Lee, H. Parental Perceptions of STEM Enrichment for Young Children. *J. Educ. Gift.* **2018**, *41*, 5–23. [CrossRef]
34. Wiebe, E.; Unfried, A.; Faber, M. The Relationship of STEM Attitudes and Career Interest. *Eurasia J. Math. Sci. Technol. Educ.* **2018**, *14*, em1580. [CrossRef] [PubMed]
35. Lytle, A.; Shin, J.E. Incremental Beliefs, STEM Efficacy and STEM Interest among First-Year Undergraduate Students. *J. Sci. Educ. Technol.* **2020**, *29*, 272–281. [CrossRef]
36. Maiorca, C.; Roberts, T.; Jackson, C.; Bush, S.; Delaney, A.; Mohr-Schroeder, M.J.; Soledad, S.Y. Informal Learning Environments and Impact on Interest in STEM Careers. *Int. J. Sci. Math. Educ.* **2021**, *19*, 45–64. [CrossRef]
37. Sakellariou, C.; Fang, Z. Self-efficacy and interest in STEM subjects as predictors of the STEM gender gap in the US: The role of unobserved heterogeneity. *Int. J. Educ. Res.* **2021**, *109*, 101821. [CrossRef]
38. Van den Hurk, A.; Meelissen, M.; Van Langen, A. Interventions in education to prevent STEM pipeline leakage. *Int. J. Sci. Educ.* **2019**, *41*, 150–164. [CrossRef]
39. Abe, E.N.; Chikoko, V. Exploring the factors that influence the career decision of STEM students at a university in South Africa. *Int. J. STEM Educ.* **2020**, *7*, 60. [CrossRef]
40. González-Pérez, S.; De Cabo, R.M.; Sáinz, M. Girls in STEM: Is It a Female Role-Model Thing? *Front. Psychol.* **2020**, *11*, 2204. [CrossRef]
41. Master, A.; Meltzoff, A.N. Cultural Stereotypes and Sense of Belonging Contribute to Gender Gaps in STEM. *Grantee Submiss.* **2020**, *12*, 152–198.
42. Parker, P.D.; Van Zanden, B.; Marsh, H.W.; Owen, K.; Duineveld, J.J.; Noetel, M. The Intersection of Gender, Social Class, and Cultural Context: A Meta-Analysis. *Educ. Psychol. Rev.* **2020**, *32*, 197–228. [CrossRef]
43. Shahali, E.H.M.; Halim, L.; Rasul, M.S.; Osman, K.; Arsad, N.M. Students' interest towards STEM: A longitudinal study. *Res. Sci. Technol. Educ.* **2018**, *37*, 71–89. [CrossRef]
44. Palmer, T.-A. Student subject choice in the final years of school: Why science is perceived to be of poor value. *Aust. Educ. Res.* **2020**, *47*, 591–609. [CrossRef]
45. Weeden, K.A.; Gelbgiser, D.; Morgan, S.L. Pipeline Dreams: Occupational Plans and Gender Differences in STEM Major Persistence and Completion. *Sociol. Educ.* **2020**, *93*, 297–314. [CrossRef]
46. Shin, D.-J.D.; Lee, M.; Ha, J.E.; Park, J.H.; Ahn, H.S.; Son, E.; Chung, Y.; Bong, M. Science for all: Boosting the science motivation of elementary school students with utility value intervention. *Learn. Instr.* **2019**, *60*, 104–116. [CrossRef]
47. Kærsgaard, J.L.B.; Christensen, M.K.; Søndergaard, P.Y.; Naukkarinen, J. Gender differences in dentistry: A qualitative study on students' intrinsic and extrinsic motivations for entering dentistry at higher education. *Eur. J. Dent. Educ.* **2021**, *25*, 495–505. [CrossRef]

48. O'Brien, L.T.; Garcia, D.M.; Blodorn, A.; Adams, G.; Hammer, E.; Gravelin, C. An educational intervention to improve women's academic STEM outcomes: Divergent effects on well-represented vs. underrepresented minority women. *Cult. Divers. Ethn. Minor. Psychol.* **2020**, *26*, 163–168. [CrossRef] [PubMed]
49. Beier, M.E.; Kim, M.H.; Saterbak, A.; Leautaud, V.; Bishnoi, S.; Gilberto, J.M. The effect of authentic project-based learning on attitudes and career aspirations in STEM. *J. Res. Sci. Teach.* **2019**, *56*, 3–23. [CrossRef]
50. McGuire, L.; Mulvey, K.L.; Goff, E.; Irvin, M.J.; Winterbottom, M.; Fields, G.E.; Hartstone-Rose, A.; Rutland, A. STEM gender stereotypes from early childhood through adolescence at informal science centers. *J. Appl. Dev. Psychol.* **2020**, *67*, 101109. [CrossRef]
51. Cairns, D.; Dickson, M. Exploring the Relations of Gender, Science Dispositions and Science Achievement on STEM Career Aspirations for Adolescents in Public Schools in the UAE. *Asia-Pac. Educ. Res.* **2021**, *30*, 153–165. [CrossRef]
52. Holmes, K.; Gore, J.; Smith, M.; Lloyd, A. An Integrated Analysis of School Students' Aspirations for STEM Careers: Which Student and School Factors Are Most Predictive? *Int. J. Sci. Math. Educ.* **2018**, *16*, 655–675. [CrossRef]
53. Wieselmann, J.R.; Roehrig, G.H.; Kim, J.N. Who succeeds in STEM? Elementary girls' attitudes and beliefs about self and STEM. *Sch. Sci. Math.* **2020**, *120*, 297–308. [CrossRef]
54. Falco, L.D. The School Counselor and STEM Career Development. *J. Career Dev.* **2017**, *44*, 359–374. [CrossRef]
55. Fouad, N.A.; Santana, M.C. SCCT and Underrepresented Populations in STEM Fields: Moving the Needle. *J. Career Assess.* **2017**, *25*, 24–39. [CrossRef]
56. Castro, A.R.; Collins, C.S. Asian American women in STEM in the lab with "White Men Named John". *Sci. Educ.* **2021**, *105*, 33–61. [CrossRef]
57. Soler, S.C.G.; Alvarado, L.K.A.; Nisperuza, G.L.B. Women in STEM: Does college boost their performance? *High. Educ.* **2019**, *79*, 849–866. [CrossRef]
58. Avolio, B.; Chávez, J.; Vílchez-Román, C. Factors that contribute to the underrepresentation of women in science careers worldwide: A literature review. *Soc. Psychol. Educ.* **2020**, *23*, 773–794. [CrossRef]
59. Fitzallen, N. *STEM Education: What Does Mathematics Have to Offer?* Queensland: Brisbane, Australia, 2015.
60. Aryee, M. College Students' Persistence and Degree Completion in Science, Technology, Engineering, and Mathematics (STEM): The Role of Non-Cognitive Attributes of Self-Efficacy, Outcome Expectations, and Interest. Ph.D. Thesis, Seton Hall University, South Orange, NJ, USA, 2017.
61. Brown, P.L.; Concannon, J.P.; Marx, D.; Dondaldson, C.W.; Black, A. An Examination of Middle School Students' STEM Self-Efficacy with Relation to Interest and Perceptions of STEM. *J. STEM Educ.* **2016**, *17*, 27–38.
62. Van Aalderen-Smeets, S.I.; Van Der Molen, J.H.W.; Xenidou-Dervou, I. Implicit STEM ability beliefs predict secondary school students' STEM self-efficacy beliefs and their intention to opt for a STEM field career. *J. Res. Sci. Teach.* **2019**, *56*, 465–485. [CrossRef]
63. Bandura, A. *Psychological Modeling: Conflicting Theories*; Routledge: London, UK, 2021. [CrossRef]
64. Bandura, A. *Social Foundations of thought and Action: A Social Cognitive Theory/Albert Bandura*; Prentice-Hall: Englewood Cliffs, NJ, USA, 1986; Volume 16.
65. DeVellis, R.F.; Lewis, M.A.; Sterba, K.R. Interpersonal Emotional Processes in Adjustment to Chronic Illness. In *Social Psychological Foundations of Health and Illness*; Blackwell Publishing: Hoboken, NJ, USA, 2003; pp. 256–287.
66. Faber, M.; Unfried, A.; Wiebe, E.; Corn, J.; Townsend, L.; Collins, T. Student Attitudes toward STEM: The Development of Upper Elementary School and Middle/High School Student Surveys. In Proceedings of the 2013 ASEE Annual Conference & Exposition Proceedings, ASEE Conferences, Atlanta, GA, USA, 23–26 June 2013; pp. 23.1094.1–23.1094.26. [CrossRef]
67. Thomas, J.; Utley, J.; Hong, S.-Y.; Korkmaz, H.; Nugent, G. Parent Involvement and Its Influence on Children's STEM Learning. In *Handbook of Research on STEM Education*; Routledge: London, UK, 2020. [CrossRef]
68. Holmlund, T.D.; Lesseig, K.; Slavit, D. Making sense of "STEM education" in K-12 contexts. *Int. J. STEM Educ.* **2018**, *5*, 32. [CrossRef]
69. Jenkins, Y.M. *Diversity in College Settings: Directives for Helping Professionals*; Routledge: London, UK, 2014. [CrossRef]
70. Plasman, J.; Gottfried, M.; Williams, D.; Ippolito, M.; Owens, A. Parents' Occupations and Students' Success in STEM Fields: A Systematic Review and Narrative Synthesis. *Adolesc Res. Rev.* **2021**, *6*, 33–44. [CrossRef]
71. Walters, L.; Walters, T.; Barwind, J. Tertiary Education in the Gulf: 'A Colossal Wreck, Remaining Boundless and Bare? In *Middle East Institute Policy Analysis*; Middle East Institute: Washington, DC, USA, 2012.
72. Sellami, A.; Santhosh, M.; Bhadra, J.; Ahmad, Z. High school students' STEM interests and career aspirations in Qatar: An exploratory study. *Heliyon* **2023**, *9*, e13898. [CrossRef] [PubMed]
73. Al-Ansari, M.; Zahirovic, I. *Contemporary National Identity in Qatar: Strong Foundations and Growing Challenges*; Springer: Singapore, 2021. [CrossRef]
74. Michael, C. Employment and Entitlement in the GCC: A World-Systems Analysis of Disrupted Development, November 2013. Available online: https://www.aub.edu.lb/ifi/Documents/publications/working_papers/2013-2014/20131120ifi_IA_wp_michael_coulom.pdf (accessed on 27 February 2023).
75. Huang, X.; Zhang, J.; Hudson, L. Impact of math self-efficacy, math anxiety, and growth mindset on math and science career interest for middle school students: The gender moderating effect. *Eur. J. Psychol. Educ.* **2019**, *34*, 621–640. [CrossRef]

76. Kang, J.; Keinonen, T.; Salonen, A. Role of Interest and Self-Concept in Predicting Science Aspirations: Gender Study. *Res. Sci. Educ.* **2021**, *51*, 513–535. [CrossRef]
77. Sheldrake, R. Changes in Children's Science-Related Career Aspirations from Age 11 to Age 14. *Res. Sci. Educ.* **2020**, *50*, 1435–1464. [CrossRef]
78. Sadler, P.M.; Sonnert, G.; Hazari, Z.; Tai, R. Stability and volatility of STEM career interest in high school: A gender study. *Sci. Educ.* **2012**, *96*, 411–427. [CrossRef]
79. Van Der Vleuten, M.; Jaspers, E.; Maas, I.; Van Der Lippe, T. Boys' and girls' educational choices in secondary education. The role of gender ideology. *Educ. Stud.* **2016**, *42*, 181–200. [CrossRef]
80. Said, Z. Science Education Reform in Qatar: Progress and Challenges. *Eurasia J. Math. Sci. Technol. Educ.* **2016**, *12*, 2253–2265. [CrossRef]
81. Nix, S.; Perez-Felkner, L. Difficulty Orientations, Gender, and Race/Ethnicity: An Intersectional Analysis of Pathways to STEM Degrees. *Soc. Sci.* **2019**, *8*, 43. [CrossRef]
82. Ashlock, J.; Stojnic, M.; Tufekci, Z. Gender Differences in Academic Efficacy across STEM Fields. *Sociol. Perspect.* **2022**, *65*, 555–579. [CrossRef]
83. Dotterer, A.M. Parent involvement, expectancy values, and STEM outcomes among underrepresented adolescents. *Soc. Psychol. Educ.* **2022**, *25*, 113–127. [CrossRef]
84. Salvatierra, L.; Cabello, V.M. Starting at Home: What Does the Literature Indicate about Parental Involvement in Early Childhood STEM Education? *Educ. Sci.* **2022**, *12*, 218. [CrossRef]
85. Lloyd, A.; Gore, J.; Holmes, K.; Smith, M.; Fray, L. Parental Influences on Those Seeking a Career in STEM: The Primacy of Gender. *Int. J. Gend Sci. Technol.* **2018**, *10*, 308–328.
86. Plasman, J.S.; Gottfried, M.; Williams, D. Following in their Footsteps: The Relationship Between Parent STEM Occupation and Student STEM Coursetaking in High School. *J. STEM Educ. Res.* **2021**, *4*, 27–46. [CrossRef]
87. Jungert, T.; Levine, S.; Koestner, R. Examining how parent and teacher enthusiasm influences motivation and achievement in STEM. *J. Educ. Res.* **2020**, *113*, 275–282. [CrossRef]