

Research Article

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UAE Students' Perceptions of the Relation Between Studying Science Through STEM and Their Aspirations for STEM Careers: The Case of Grades 9th and 10th in Al Fujairah

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Abstract

Background/purpose. STEM (Science, Technology, Engineering, and Mathematics) education is becoming increasingly important in the United Arab Emirates (UAE), due to the country's rapid economic expansion and the demand for STEM-qualified graduates. Curriculum creators and policymakers have realized the importance of integrating STEM education at all levels. This study aims to investigate the relationship between science education in STEM programs and students' career goals in STEM-related fields, with a focus on potential disparities related to gender and grade level.

Materials/methods. A quantitative study approach was employed, with a survey distributed to 9th- and 10th-grade students in Al Fujairah. The sample size consisted of 1,100 students, and the data were analyzed using repeated-measures analysis and correlational methodologies to investigate patterns of career ambitions and interest in STEM.

Results. According to the data, students in STEM programs are more interested in STEM careers and future goals than their peers who do not attend STEM programs. The results also showed that girls were more interested in STEM than boys. These findings demonstrate that STEM education fosters students' critical thinking, creativity, and career motivation. Expanding STEM-based activities and learning opportunities may improve students' involvement and enthusiasm in STEM disciplines.

Conclusion. The findings provide valuable insights for UAE educational officials as they develop strategies to enhance student engagement in STEM education and contribute to creating a competent workforce that meets the country's future needs.

1. Introduction

The STEM program in the UAE (Science, Technology, Engineering, and Mathematics) education has become a national priority as the government seeks to diversify its economy, advance technological innovation, and guide its students toward future job opportunities. The UAE Vision 2031, specifically the National Agenda, National programs, and the Think Science program, emphasize the need to prepare students for a knowledge-based economy. These efforts align with global trends that emphasize the need for skilled employees capable of responding to rapidly changing technologies, artificial intelligence, and industry advancements.

In this context, improving STEM education is crucial for enhancing academic achievement, promoting innovation and creativity, and cultivating a strong pipeline of Emirati role models in STEM professions.

Previous studies have consistently shown that STEM education can enhance students' problem-solving skills, critical thinking, and motivation to pursue science-related careers. According to research (Cairns & Dickson, 2021), students' science achievement correlates positively with their goals for career choices in STEM fields, with differences in gender influencing the level of these correlations. Integrated STEM instruction, which emphasizes connections across disciplines, has been found to increase enthusiasm for STEM learning (Thibaut et al., 2018), while programs such as PRISM in the United States have demonstrated that hands-on STEM experiences can nurture students' interests and lead to more science-related career choices (Carpi et al., 2017). At the same time, challenges in implementing STEM remain widespread, including limited teacher preparedness, heavy workloads, inadequate resources, and low student interest in STEM subjects (Al Murshidi, 2019; Shaer et al., 2019).

Despite these international and regional findings, little research has examined how STEM education in the UAE shapes students' aspirations for STEM careers, particularly in less-studied regions such as Al Fujairah. Most existing studies have concentrated on broader national policies or urban educational contexts, leaving a gap in understanding how students in different Emirates perceive STEM and how these perceptions affect their career intentions. Highlighting the gap is essential for policymakers, instructors, and educators because it reveals how STEM activities translate into student preparation for future job paths in science, technology, engineering, and math.

This study examines the relationship between students' participation in STEM programs and their aspirations for STEM careers among 9th- and 10th-grade students in Al Fujairah, UAE. Specifically, it examines whether gender- and grade-level differences exist in students' attitudes toward STEM and their career interests. To guide this inquiry, the study addresses the following research questions:

1. What is the relationship between studying science through STEM and aspirations for STEM careers among ninth- and tenth-grade students in Al Fujairah?
2. Are there significant gender-based and grade-level differences in career aspirations for and interest in STEM among ninth- and tenth-grade students in Al Fujairah?

2. Literature Review

STEM education is seen as a game-changer. According to Qablan (2021), several studies have demonstrated an increasing demand for STEM professionals in the future. Therefore, stakeholders must ensure that the next generation is well-trained in STEM areas to meet these needs when they arise. STEM covers a wide range of expertise and experience. English (2016) argued that STEM stands for science, technology, engineering, and mathematics; education should include "real-world, problem-based learning" that links the four disciplines through cohesive and active teaching and learning

techniques. As a new approach to teaching and learning, STEM education aims to equip the next generation with the skills necessary to thrive in the modern world.

According to the Theoretical Framework, Social Cognitive Career Theory (SCCT) is a theoretical model presented by Lent et al. (1994) to examine aspects related to career interests, career choices, and career attainment in individuals, with significant elements that draw on cognitive psychology, social psychology, and career development. In its conceptual framework, SCCT focuses on the bidirectional relationships between people-level variables, including self-efficacy beliefs, interests, outcome expectations, and goals, and contextual-level characteristics, including social contexts, cultural norms, and organizational supports, and behavior, including exploration, decision-making, and goal-settings processes, that influence individuals' career paths and processes at various stages.

The UAE's concern with the STEM approach, as noted by Rockland et al. (2010), calls for inquiry-based learning, problem-solving, and a discovery-based method. These work policies encourage student-centered or problem-based learning approaches, which are crucial to their endeavors in STEM-related courses.

According to Kelly and Knowles (2016), there is a need to enhance the integration of experience-based themes between science and reality through integrative STEM education. This integration helps address the pertinent issue that distances students in their education, especially in the sciences, preparing them well to pursue their careers in STEM fields.

Students in the ninth and tenth grades in Al Fujairah have a positive perception of learning science with the help of STEM, and there is a higher probability that they will pursue careers in STEM industries. Satchwell and Loepp (2002) outline the difference between interdisciplinary and integrated curricula, where integrated curricula are in which ideas from different disciplines are intermingled with ideas from other disciplines to afford equal value to all the disciplines. In this approach, STEM learning can be expanded to encompass most aspects of learning, thereby increasing student interest in STEM subjects and, consequently, STEM careers.

STEM has become a central area of focus in school education reform worldwide, including in the UAE. The UAE, with its Vision 2021, aims to shift to a knowledge economy, and for this to happen, STEM education must improve. From this national directive, various strategies have been implemented to improve STEM education and increase interest in these areas.

The study by Madani (2020) evaluated the status, issues, and viable solutions in STEM education in the UAE. From this study, we observed that students' interest in STEM courses varies significantly as society continues to increase its appreciation for these fields. High tuition costs were identified as an impediment to STEM education, corroborated by enrollment costs in many programs, which raised concerns about accessibility to learners of varying financial capabilities. This, inferred from the financial restraints, conveys a comparatively less distinct interest and engagement among students in STEM subjects.

The link between students' interests in STEM courses and their career path choices has been established. Research indicates that students' early experiences with STEM education and their activity levels can potentially impact their career choices in later life. There should be a direct link between the perception of competency in math and the perceived practical application of the content.

Students who are more engaged in STEM activities and learning content are more likely to later pursue STEM-related careers. Examining the various factors, curiosity, utility value, and self-efficacy were found to be key antecedents that motivate students interested in pursuing STEM-related careers (Sellami et al., 2022). Nonetheless, these dreams were not free from the constraints imposed by neighboring influences, especially those of family and economic status.

This paper posits that establishing how students' interest in STEM is influenced by their career aspirations is crucial. Specifically, it explores the following: Nodoot: Although gender is a significant variable determining students' interest in STEM and fantasy careers, little is known about how this determinant impacts the two (Makransky et al., 2020). Students' gender has been a key issue that influential researchers have highlighted, indicating that STEM fields often attract more male students than female students, and these students tend to exhibit a greater interest in STEM-related subjects.

Gender is a significant factor in determining students' interest in STEM-related fields and their career choices. STEM education in the UAE has also revealed that men major in STEM areas, while women are considerably underrepresented (Mallinson & Hudley, 2014). This has resulted from the working environment and culture that some societies and employers have instilled in women that they should not take up technical jobs. In other areas, the UAE has been quite progressive over the years; however, the country's culture remains fairly conservative when it comes to the portrayal of women, focusing on how they should be rather than the education they should receive, which is a problem that has been observed. This societal narrative leads to fewer female students being inclined towards STEM-related courses, thus deepening the divide.

This divide begins in early education, as girls are encouraged and influenced to pursue humanities and arts, while boys are directed to take technology courses. Such changes can only be achieved through public awareness campaigns, which generally form the basis of promotional programs. These programs should include successful female professionals in STEM careers and showcase that these jobs are fulfilling. Similarly, providing opportunities for female students to socialize and interact with others will help them regain their confidence in STEM education and careers. Therefore, to tackle gender inequalities in STEM education, the following measures are necessary: policy changes at the institutional and governmental levels; modifications to curricula and teaching-learning processes; the elimination of gender stereotypes in society; and encouraging girls to pursue STEM careers in the same way as boys. in summary

STEM is defined by integrating information through meaningful learning experiences, real-world problem-solving, and connection. STEM students draw meaningful connections between science and their everyday experiences. STEM education is crucial for learning and teaching, preparing students for college and the workplace. Despite these encouraging signs, there may still be barriers to engaging students in STEM education, as well as disparities in gender distribution. Additionally, teaching methods could be more effective in the UAE.

The literature review reveals an increasing concern about STEM education; however, various challenges, including the high cost of tuition, a lecture-based approach, and inadequate resource allocation, have been identified as influential in students' disengagement. Generally, there is a strong correlation between interest in STEM courses and career interests. However, these factors also have external influences, such as parental advocacy and socioeconomic status.

3. Methodology

The study focused on STEM schools. The study was conducted in the Al Fujairah educational zone, which was chosen since the researcher could easily reach schools in the area. The selected schools were from cycle 3 of the UAE education system, which includes grades 9 through 12. The Ministry of Education (MOE) classifies grades 1-4, 5-8, and 9-12 into three cycles. The MOE (Ministry of Education) actively inspires STEM practices by offering teacher training, requiring instructors to document their teaching methods, and organizing yearly innovation and science events. Both public and private schools engage in project-based learning initiatives that emphasize STEM.

The research was carried out during the academic year 2023–2024. The researcher coordinated with the Ministry of Education (MOE) Education office in Fujairah to obtain permission to access schools and collect the data.

The UAE's educational reforms, which are connected with Abu Dhabi's Economic Vision 2030 and the MOE's strategic plan, focus on assisting STEM education, integrating technology in schools, and building a competent workforce to help a knowledge-based economy.

3.1. Research Method

A quantitative study approach was employed to investigate the association between STEM education and the job goals of Al Fujairah's ninth— and tenth-grade pupils. Quantitative approaches provide systematic data collection and statistical assessment of correlations while reducing subjective bias (Bryman, 2011; Seedhouse, 2005).

The study employed pre- and post-test surveys to evaluate changes in students' aspirations for STEM-related careers. The STEM Job Interest Survey (STEM-CIS) assessed students' STEM career goals. The independent variable was students' involvement in STEM classes and activities.

3.2. Research Design

The study employed a quantitative design to test whether established theories of career choice and interest (SCCT) are applicable in the UAE context. Correlational analyses were used to identify relationships between interest in STEM subjects and career intentions.

3.2.1. Sampling

The population consisted of 9th- and 10th-grade students enrolled in STEM classes in Fujairah public schools. According to Ministry of Education (MOE) data, the Cycle 3 population included approximately 3,585 students across grades 9 and 10.

A total of 1,100 students were recruited. Due to accessibility limits, a convenience sample strategy was employed. Students were selected in collaboration with principals and teachers based on their participation in STEM activities and classes. While convenience sampling allowed efficient access to participants, it does not guarantee representativeness of the broader student population (Etikan et al., 2016)

3.2.2. Data Collection

The STEM-Career Interest Survey (STEM-CIS) was used to collect data, which is a 44-item, 5-point Likert-type scale that assesses goals for STEM jobs.

The questionnaire was completed online using Google Forms. The survey was disseminated between September and October 2023, with clearance from the Ministry of Education (MOE) and consent from school principals, parents, and students.

3.2.3. Data Analysis

The following inferential statistics were used in SPSS v29 to analyze the quantitative data and determine a relationship between STEM education and the intended jobs of 9th and 10th graders in Al Fujairah. During the process, Cronbach's alpha coefficients (STEM-CIS: $\alpha = 0.93$) were used for reliability estimation on the Likert-type questionnaire.

The descriptive statistics employed when defining the response rates included frequencies, percentages, means, and standard deviations. These statistics are relevant for answering research questions. Descriptive statistics were employed to identify the numerical differences in students' desires to pursue STEM careers and their participation in STEM-related activities in Al Fujairah, particularly among 9th and 10th graders. The linear relationship between the variables was tested

using Pearson correlation. STEM domains and career aspirations. This approach is suitable when evaluating the relationship between two continuous variables, provided the assumptions of normality, linearity, and homoscedasticity are met. Moreover, a regression analysis was employed to assess the incremental contribution of students' interest in science in predicting STEM career aspirations, while controlling for other predictors. Regression assumes the absence of multicollinearity, linearity of relationships, independence of errors, homoscedasticity, and normally distributed residuals (Tabachnick & Fidell, 2019). Diagnostic checks were performed prior to analysis, and non-parametric alternatives were considered if the assumptions were not met.

(MANOVA) Multivariate analysis of variance was used to examine group differences (gender, grade level) in STEM attitudes and career aspirations. MANOVA is suitable when assessing multiple dependent variables simultaneously, assuming multivariate normality and homogeneity of covariance matrices (Hair et al., 2019).

3.3. Validity of the Instrument

First, the researcher requested the final copy of the questionnaire that Altoum (2021) used in the study. Secondly, to ensure that the STEM questionnaire is robust in measuring all aspects of the SCCT among students while remaining easily understandable, the researcher consulted with two scientific instructors. Finally, the pilot study involved 50 high school students who were enrolled in STEM courses. In this pilot study, the researcher followed up on the aspects discussed in this document and identified, through the students' input, clear items in the test and those that were not so clear and should be removed. The above procedures yielded the item and subscale validities.

To get the meaning of the STEM construct, it was necessary to relate STEM statements to SCCT constructs (Kier et al., 2013). STEM statements were compared to SCCT dimensions, which included self-efficacy, interest, result expectancies, personal objectives, and obstacles. Kier et al. (2013) found a strong positive correlation ($r = 0.56-0.76$) between the SCCT components and the STEM items.

3.4. Reliability of the Instrument

When repeated administrations of a survey provide the same results, the survey is considered dependable (Creswell & Creswell, 2017). Based on Cronbach's alpha values for internal consistency, the instrument's Cronbach's alpha was 0.84. Establishing interrelations among the four subscales and their joint applicability are crucial in measuring student aspirations. To determine the ability to merge four subscales into one, Kier et al. (2013) illustrated their relations and reported a 645-correlation ranging from 0.72 to 0.82. The four subscales proved to be positively related and suitable for detecting students' intentions toward science-related jobs. The researcher calculated Cronbach's alpha, it was 0.79 for science, 0.94 for technology, 0.93 for engineering, 0.95, and 0.98 for mathematics.

3.5. Ethical Considerations

Once the researcher received approval from the Ministry of Education, they wrote an online permission form for parents to allow their children to participate in the study. To ensure the privacy of the participants, the researcher kept the responses anonymous. Anonymity was preserved by requesting no names, student numbers, or other information that could identify individual students. All data were stored securely on a password-protected computer.

3.6. Summary

This chapter demonstrated that the quantitative approach is more suitable for seeking how the delivery of learning science through STEM enhances students' perceptions of the possibilities of pursuing STEM careers in the future. While the study employs robust quantitative techniques, the limitations of non-probabilistic sampling and the single regional context restrict the generalizability

of the findings. Nevertheless, the study offers meaningful insights into the relationship between STEM education and student career aspirations within the Fujairah context.

4. Results

RQ1: What is the relation between studying science through STEM and aspirations for STEM careers among ninth and tenth graders in Al Fujairah?

Pearson product-moment ordinary correlation coefficient analysis was used to determine the relationship between career aspirations and interest in each STEM domain. With regard to science, there was a perfect relation between vocational interest in science and the chosen profession ($t = 5.06$, $p = 0.001$). Specifically, in the technological field, a strong positive correlation was found between interest in technology and career intentions ($r = 0.86$, $p = 0.001$). For engineering, a strong positive relationship was found between interest in the engineering field and career goals (chi-square coefficient of 0.61, corresponding to a probability level of 0.001). In mathematics, a positive relationship was also observed between interest in mathematics and intended career choice, with a correlation coefficient of $r = 0.84$ and $p = 0$. The results of the Pearson product-moment correlation analysis in predicting interest in STEM from career aspirations yielded a significant and positive value of $r = 0.93$ with a p value of 0.001.

4.1. Predictors of Career Aspirations

First, hierarchical regression was performed to explore the level of interest in science and its contribution to the variance in career aspirations (Table 1). While interest in science was operationalized as an independent variable, science career aspirations served as the dependent variable. Second, two demographic variables were added to the model. In step 1, science interest contributed significantly to the variance in science career aspirations ($1, 1093 = 2060.54$, $p = 0.001$). Science interest ($b = 0.81$, $p = 0.001$) made a 65% contribution to the variance in science career aspirations. In step 2, the two demographics made no significant contributions to the variance in science career aspirations ($2, 1092 = 2.11$, $p = 12$). The contribution of demographic variables to the variance in science career aspirations was 0.10%. However, the combined model, including demographic variables and science interest, was significant ($F(3, 1093) = 689.65$, $p < 0.001$). Only interest in science ($b = 0.82$, $p = 0.001$) and gender ($b = -0.04$, $p = 0.04$) made significant contributions to the variance in career aspirations.

Table 1. Regression for the Contribution of Interest in Science to Career Aspirations

Step	Category	Unst. Beta	S.E.	Stand Beta	T	P
Step 1	Interest in science	1.58	0.04	0.81	45.39	0.001**
	Interest in science	1.60	0.04	0.82	44.32	0.001**
Step 2	Grade level	-.08	0.18	-0.008	-0.43	0.67
	Gender	-0.47	0.23	-0.04	-2.04	0.04*

** $p = 0.001$, * $p = 0.05$, Unst. Beta = unstandardized beta, S.E. standard error, $t = t$ -test, the probability value (p).

Additionally, hierarchical regression was performed to determine the contribution of interest in technology to variance in career aspirations (Table 2). Although interest in technology was operationalized as an independent variable, career aspirations were used as a dependent variable. Two demographic variables were added to the model. In step 1, the contribution of technological interest to the variance in career aspirations was significant ($F(1, 1093) = 2,218.68$, $p < 0.001$). Technology interest ($b = 0.82$, $p < 0.001$) accounted for a 67% contribution to the variance in career

aspirations. In step 2, the two demographics made no significant contributions to the variance in career aspirations ($F(2, 1092) = 0.33, p = 0.72$). The contribution of demographic variables to the variance in science career aspirations was 0.00%. However, the combined model (including demographic variables and science interest) was significant ($F(3, 1093) = 738.88, p < 0.000$). Only interest in technology ($b = 0.82, p = 0.000$). and gender ($b = -0.01, p = 0.469$) made significant contributions to the variance in career aspirations.

Table 2. Regression for the Contribution of Interest in Technology to Career Aspirations.

Step	Category	Unst. Beta	S.E.	Stand. Beta	T	P
Step 1	Interest in Technology	1.12	0.024	0.82	47.10	0.001**
Step 2	Interest in Technology	1.12	0.024	0.82	46.6	0.001**
	Grade level	0.04	0.15	0.01	0.274	0.684
	Gender	-0.132	0.18	-0.01	-0.73	0.469*

** $p = 0.001$, * $p = 0.05$, Unst. Beta = unstandardized beta, S.E. standard error, $t = t$ -test, the probability value (p).

Additionally, hierarchical regression analysis was conducted to explore the contribution of students' interest in engineering to the variance in career aspirations (Table 3). While interest in engineering was operationalized as an independent variable, career aspirations were used as a dependent variable. Two demographic variables were added to the model. In step 1, the contribution of engineering interest to the variance in career aspirations was significant ($F(1, 1091) = 7243.18, p = 0.000$). Engineering interest ($b = 0.93, p = 0.000$) made an 87% contribution to the variance in career aspiration. In step 2, neither of the two demographics made a significant contribution to the variance in career aspirations ($F(2, 1090) = 3.55, p = 0.001$). The contribution of the demographic variables to the variance in career aspirations was 0.1%. However, the combined model (including demographic variables and science interest) was significant ($F(3, 1091) = 2428.06, p < 0.000$). Only interest in technology ($b = 0.94, p = 0.000$) and gender ($b = 0.0214, p = 0.05$) made significant contributions to the variance in career aspirations.

Table 3. Regression for the Contribution of Interest in Engineering Career Aspirations.

Steps	Category	Unst. Beta	S.E.	Stand. Beta	T	P
Step 1	Interest in Engineering	1.12	0.01	0.93	58.12	0.001**
	Interest in Engineering	1.21	0.01	0.94	84.95	0.001**
Step 2	Grade level	-0.184	0.18	0.02	1.57	0.12
	Gender	-0.28	0.14	-0.02	-1.93	0.05*

** $p = 0.001$, * $p = 0.05$, Unst. Beta = unstandardized beta, S.E. standard error, $t = t$ -test, the probability value (p).

Hierarchical regression was also performed to explore the contribution of students' interest in mathematics to the variance in career aspirations (Table 4). While interest in mathematics was operationalized as an independent variable, career aspirations were used as a dependent variable. Two demographic variables were added to the model. In step 1, the contribution of mathematics interest to the variance in career aspirations was significant ($F(1, 1081) = 2658.86, p = 0.000$). Math interest ($b = 0.84, p = 0.000$) made a 71% contribution to the variance in career aspiration. In step 2, the two demographics made no significant contributions to the variance in career aspirations ($F(2, 1080) = 1.79, p = 0.17$). The contribution of the demographic variables to the variance in career

aspirations was 0.1%. However, the combined model (including demographic variables and mathematics interest) was significant ($F(3, 1081) = 888.78, p < 0.000$). Interest in mathematics ($b = 0.85, p = 0.000$) and grade level ($b = -0.03, p = 0.13$) made significant contributions to the variance in career aspirations.

Table 4. Regression for the Contribution of Interest in Mathematics to Career Aspirations.

Steps	Categories	Unst. Beta	S.E.	Stand. Beta	T	P
Step 1	Interest in Mathematics	0.94	0.02	0.83	51.57	0.001**
	Interest in Mathematics	0.95	0.02	0.85	50.65	0.001**
Step 2	Grade level	-0.22	0.15	-0.025	1.51	0.13
	Gender	-0.17	0.18	-0.02	-0.95	0.34*

** $p = 0.001$, * $p = 0.05$, Unst. Beta = unstandardized beta, S.E. standard error, $t = t$ -test, the probability value (p).

Furthermore, hierarchical regression analysis was conducted to explore the contribution of students' interest in all STEM items to the variance in career aspirations (see Table 5). While interest in all items was operationalized as an independent variable, career aspirations were used as a dependent variable. Two demographic variables were added to the model. In step 1, the contribution of interest in all items to the variance in career aspirations was significant ($F(1, 1065) = 8280.18, p = 0.000$). Interest in all items ($b = 0.94, p = 0.02$) made an 88% contribution to the variance in science interest. In step 2, the two demographics made no significant contributions to the variance in all career aspiration items ($F(2, 1064) = 0.002, p = 0.001$). The contribution of the demographic variables to the variance in career aspirations was 0.2%. However, the combined model (demographic variables and all items of interest) was significant ($F(3, 1065) = 2800.3, p = 0.000$). Only interest in all items ($b = 0.95, p = 0.000$) and gender ($b = -0.04, p = 0.00$) made significant contributions to the variance in career aspirations.

Table 5. Regression for the Contribution of Interest in STEM to Career Aspirations.

Steps	Categories	Unst. Beta	S.E.	Stand. Beta	T	P
Step 1	Interest in STEM	1.35	0.02	0.94	90.99	0.001**
	Interest in STEM	1.36	0.02	0.95	90.38	0.001**
Step 2	Grade level	0.43	0.34	-0.01	1.28	0.20
	Gender	-1.47	0.41	-0.04	-3.55	0.00*

** $p = 0.001$, * $p = 0.05$, Unst. Beta = unstandardized beta, S.E. standard error, $t = t$ -test, and the probability value (p).

RQ2: Are there significant gender-based and grade-level differences in career aspirations for and interest in STEM among ninth and tenth graders in Al Fujairah?

4.2. Differences in Science Interest and Career Aspirations

To compare students' interest in science and their career paths the estimate of the multivariate analysis of variance (MANOVA) was computed. Hypothesis 6a was also accepted since there were observed value differences in grade level $F(2, 1088) = 6$. Wilks' Lambda: 0.96, $p = 0.001$, with small measure of magnitude, partial eta squared = 0.02, $p < 0.001$, as well as main effects for age, certain personality traits and gender, ($F(2, 1091) = 38.83, p = 0.001$, with a moderate effect size, partial eta squared = 0.07).

As for the grade level variable, first order interactions were felt with students differing in terms of interest $F(4, 1094) = 7.94$, $p = 0.001$, once again suggesting only a very small effect size, partial eta squared = 0.03, p level = 0.05 with a medium effect size $\eta^2 = 0.02$ to the experimental group, yet there was a significant difference in aspiration ($F(4, 1094) = 2.71$, $p = 0.03$, statistically significant, but the effect size was relatively small, partial eta squared = 0.01). After the comparisons were made, it was found that grade 9 was significantly different from grade 10 of the study. The mean scores indicated that the responses from grade 9 students were less than those of the grade 10 students.

Table 6. Differences between Students in Science Interests and Aspirations

Category	Wilks' Lambda	MAN. F	ANOVA F.	
			Interest	Aspiration
Grade level	0.96	6.29**	7.94**	2.71**
Partial eta squared		0.02	0.03	0.01
Gender	0.93	38.83**	73.41**	31.85**
Partial eta squared		0.07	0.06	0.03

** $p = 0.001$

4.3. Differences in Technology Interest and Career Aspirations

MANOVA was calculated to assess the difference between students' interest in technology and career aspirations. As seen in Table 7, differences were observed between participants in grade level ($F(2, 1088) = 3.65$, Wilks' lambda = 0.97, $p = 0.001$ with a small effect size, partial eta squared = 0.01) and gender ($F(2, 1091) = 11.36$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.02).

Regarding grade level, individual differences were observed between students in interest ($F(4, 1094) = 3.83$, $p = 0.004$, with a small effect size, partial eta squared = 0.01) and career aspirations ($F(4, 1094) = 3.18$, $p = 0.01$, with a small effect size, partial eta squared = 0.01). The post-comparison showed that grade 9 students differed from those in grade 10 of the study. The mean scores showed that those in grade 9 had lower scores compared with grade 10.

For gender, individual scores showed differences between students in technology interest ($F(1, 1094) = 22.14$, $p = 0.001$ with a small effect size, partial eta squared = 0.02) and career aspirations ($F(1, 1094) = 11.52$, $p = 0.001$, with a small effect size, partial eta squared = 0.02). Girls showed more interest in and aspirations for technology than boys.

Table 7. Differences between Students in Technology Interests and Aspirations

Category	Wilks' Lambda	MAN. F	ANOVA F.	
			Interest	Aspiration
Grade level	0.97	3.05**	3.83**	3.18**
Partial eta squared		0.01	0.01	0.01
Gender	0.98	11.36**	22.14**	11.52**
Partial eta squared		0.02	0.02	0.02

** $p = 0.001$

4.4. Differences in Engineering Interests and Career Aspirations

MANOVA was used to examine the differences between students in their interest in engineering and career aspirations. As Table 8 shows, differences were observed between participants in grade level ($F(2, 1086) = 3.57$, Wilks' lambda = 0.97, $p = 0.001$, with a small effect size, partial eta squared = 0.01) and gender ($F(2, 1091) = 11.35$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.02).

Concerning grade level, individual differences were observed between students in interest ($F(4, 1092) = 4.23$, $p = 0.002$, with a small effect size, partial eta squared = 0.02) and aspiration ($F(4, 1092) = 4.29$, $p = 0.002$, with a small effect size, partial eta squared = 0.02). Post-comparison showed that grade 9 students differed from grade 10 students in the study. Mean scores showed that those in grade 9 had lower scores compared with grade 10.

For gender, individual scores showed differences between students in engineering interest ($F(1, 1092) = 10.33$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.009) and career aspirations ($F(1, 1092) = 4.9$, $p = 0.001$, with a small effect size, partial eta squared = 0.004). Girls showed more interest in and had higher aspirations for engineering than boys.

Table 8. Differences between Students in Engineering Interest and Aspirations.

Category	Wilks' Lambda	MAN. F	ANOVA F.	
			Interest	Aspiration
Grade Level	0.97	3.57**	4.23**	4.29**
Partial eta squared		0.01	0.02	0.02
Gender	0.98	11.35**	10.33**	4.9**
Partial eta squared		0.02	0.009	0.004

** $p = 0.001$

4.5. Differences in Mathematics Interest and Career Aspirations

MANOVA was used to assess the difference in students' interest in mathematics and their career aspirations. Table 9 shows that differences were observed between participants in grade level ($F(4, 1086) = 3.57$, Wilks' lambda = 0.97, $p = 0.001$, with a small effect size, partial eta squared = 0.01) and gender ($F(2, 1079) = 25.91$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.05).

Regarding grade level, individual differences were observed between students in interest ($F(4, 1082) = 6.10$, $p = 0.001$, with a small effect size, partial eta squared = 0.02) and aspiration ($F(4, 1082) = 3.82$, $p = 0.01$, with a small effect size, partial eta squared = 0.01). Post-comparison showed that grade 9 students differed from grade 10 students in the study. Mean scores showed that those in grade 9 had lower scores compared to those in grade 10.

For gender, individual scores showed differences between students in mathematics interest ($F(1, 1082) = 50.5$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.06) and career aspirations ($F(1, 1082) = 28.34$, $p = 0.001$, with a small effect size, partial eta squared = 0.03). Girls showed more interest in and higher aspirations for mathematics than boys.

Table 9. Difference between Students in Mathematics Interest and Aspirations

Category	Wilks' Lambda	MAN. F	ANOVA F.	
			Interest	Aspiration
Grade Level	0.97	3.57**	4.23**	4.29**
Partial eta squared		0.01	0.02	0.02
Gender	0.98	11.35**	10.33**	4.9**
Partial eta squared		0.02	0.009	0.004

** $p = 0.001$

4.6. Differences in Overall Interest and Career Aspirations in STEM

MANOVA was calculated to assess the difference between students in terms of overall interest and career aspirations. As shown in Table 10, differences were observed between participants in grade level ($F(2, 1069) = 5.18$, Wilks' lambda = 0.96, $p = 0.001$, with a small effect size, partial eta squared = 0.02) and gender ($F(2, 1063) = 27.4$, $p = 0.001$, with a moderate effect size, partial eta squared = 0.05).

For grade level, individual differences were observed between students in interest ($F(4, 1066) = 6.82$, $p = 0.001$, with a small effect size, partial eta squared = 0.001) and aspiration ($F(4, 1066) = 4.29$, $p = 0.016$, with a small effect size, partial eta squared = 0.01). Post-comparison showed that grade 9 students differed from students in other grades. Mean scores showed that those in grade 9 had lower scores compared with grade 10.

Concerning gender, individual scores showed differences between students in overall interest ($F(1, 1066) = 40.50$, $p = 0.001$, with moderate effect size, partial eta squared = 0.04) and career aspirations ($F(1, 1066) = 22.09$, $p = 0.001$, with a small effect size, partial eta squared = 0.02). Girls showed more interest and overall aspirations than boys.

Table 10. Differences between Students in Overall Science Interests and Aspirations

Category	Wilks' Lambda	MAN. F	ANOVA F.	
			Interest	Aspiration
Grade level	0.96	5.18**	6.82**	4.29**
Partial eta squared		0.02	0.001	0.02
Gender	0.95	27.4**	40.5**	22.09**
Partial eta squared		0.02	0.001	0.02

** $p = 0.001$

4.7. Summary of Results

More specifically, the study focused on students' perceptions of STEM disciplines and the interactions between their various aspects. It also sought to explore students' preferences regarding STEM classes and their willingness to pursue STEM-related careers, and suggested enhancing STEM education in the UAE. The UAE has adopted and encouraged STEM education in schools as a step towards creating a knowledge-based economy and a globally competitive nation. However, STEM education is not given the attention it deserves; it is neither well implemented nor effectively

implemented. (Makhmasi, Rachad, & Al-Hammadi, 2012). It is important to note that this particular study employed quantitative techniques. It was also found that students in the sample had a positive perception regarding the implementation of the STEM program (Basha, 2018).

Moreover, the findings revealed that a repeated-measures analysis of variance revealed that students in STEM programs had significantly different career aspirations and future goals compared with those not in STEM. To investigate the relation between STEM field interest and career goals, the Pearson product-moment correlation coefficient was calculated. Interest in science and the desire to pursue a career in the field were positively correlated. The findings also showed a statistically significant impact of gender.

Differences were observed between the pre-test and the post-test in total, with a small effect size, indicating that students held more positive attitudes toward STEM by the post-test.

5. Discussion

RQ1: What is the relation between studying science through STEM and aspirations for STEM careers among ninth and tenth-graders in Al Fujairah?

The outcomes have revealed that students' expectations of being employed in STEM-related professions and concentrating on STEM fields were significantly elevated after they acquired science through STEM. Wickens et al. (2018) determined that positive attitudes towards STEM fields and careers significantly enhance when students engage in STEM-related extracurricular activities, as concluded by Wickens et al. (2018) and Huziak-Clark et al. (2015). According to the cross-sectional survey, this study found that student interest in STEM degrees and careers increased significantly after participating in the program. This may have been a result of the students benefiting from STEM-based lessons that incorporated both theoretical and applied elements of the mentioned fields.

The relevance of STEM activities is important when it comes to students career and degree aims (Kitchen et al., 2018; Bottia et al., 2015; Means et al., 2016). Hands-on STEM activities can help shift students' mindsets toward conventional STEM careers and develop a vocational sense of the enormous opportunities that lie ahead of them (Ozis et al., 2018). Moreover, Phelps et al. (2018) have highlighted the benefits of STEM programs, which incorporate project-based, innovative, creative, and hands-on technology learning methodologies. Creativity in STEM-related projects could be a key feature of learning that suits any students who show a deep interest in engineering, as seen in the work of Nite et al. (2017).

Numerous factors make it so beneficial for building a positive relationship. According to the guides provided by principals enrolled in Averill (2018), Rogers (2007), and Scott (2012), it was established that the effectiveness of STEM programs is solely determined by leadership quality. Scott (2012) also identified that there is compelling evidence that STEM-focused schools require leaders who are confident visionaries who see their contribution as positively impacting the lives of their students. Wang et al. (2011) also highlighted a similar challenge in the implementation of STEM education in their study and proposed a few guidelines that teachers are required to follow when addressing STEM issues in their classroom practice.

This result aligned with the SCCT, which posits that students' job choices, roles, and decisions, as well as their self-efficacy beliefs and outcome expectations regarding their careers, are shaped by both individual and contextual factors (Lent, 1994).

The conclusion presented in this study aligns with the discussion, providing evidence on the impact of STEM education on students' interest and career choices. They were, therefore, provided with skills in STEM-based science, and this study evidenced that students' aspirations for STEM careers and the specialized area of science were enhanced. This concurs with Wickens et al. (2018),

who noted that students' perceptions of STEM and STEM-related careers improved, a positive sign, after participating in educational STEM-related extracurricular activities, as reported by Phelps et al. (2018) and Huziak-Clark et al. (2015).

A similar positive change in students' attention to STEM degrees and jobs was also observed in the current study following the STEM activities; this may be attributed to both the theoretical and practical aspects of STEM activities. Furthermore, they noted that such experiences in STEM fields are instrumental in shaping students' lives and the programs they pursue, as emphasized by Kitchen et al. (2018), Bottia et al. (2018), and Means et al. (2016). Since the activities demonstrated are highly physical, it is not difficult to transform their perception towards more traditional STEM occupations; numerous career openings exist (Ozis et al., 2018). This study's findings reinforce the importance of practical, hands-on experiences in STEM, showing significant positive correlations between STEM interest and career aspirations (science: with technology: $r = 0.86$, engineering: For current month, it gives $r = 0.61$, mathematics: They have always existed in modern society, thus the first premise, $r = 0.84$ and overall STEM: Based on the results obtained, the following conclusions can be made: The model can be considered effective as it reached zero error after 4 iterations 0.93 while for the overall, $r = 1$. The lower value overall might be due to the type of data collected, among other factors.

The discussion also focuses on the leadership element and quality in STEM instructional processes. From Averill (2018), Rogers (2007), and Scott (2012), it can be deduced that STEM initiative strategies require effective leadership with a noble vision of improving students. Supporting this, Wang et al. (2011) provided recommendations for successful STEM integration. The study's findings show that interest in STEM fields significantly predicts career aspirations (science: $b = 0.82$, engineering: $b = 0.93$, mathematics: $b = 0.84$, overall STEM: $b = 0.94$), highlighting the importance of leadership and quality education. Therefore, gender and grade level differences were evident in both STEM interest and STEM aspiration. Specifically, female students expressed more interest and aspiration compared to male students.

Additionally, ninth graders were observed to have lower STEM interest compared to tenth graders. This aligns with the study's findings, which revealed significant differences across gender and grade levels (e.g., science: partial eta squared for gender was 0.07, and partial eta squared for grade level was 0.02). The study's findings, which indicate that students in Al Fujairah express a keen interest and ambition in STEM-related careers, further suggest that gender-specific approaches are needed to address the existing inequities and ensure girls' continued engagement in STEM. According to Lent (1994), the course of students' career interest and decisions involves self-efficacy, outcome expectations, and contextual influences as enshrined in the Social Cognitive Career Theory (SCCT). The variables that comprised the overall model and the significant predictors of career aspirations indicate that the components of SCCT are supported by the research, which also underscores the significance of contextual and experiential factors in influencing the STEM career aspirations of students.

RQ2: Are there significant gender-based and grade-level differences in career aspirations and interest in STEM among 9th and 10th-graders in Al Fujairah?

The findings demonstrated a statistically significant impact of gender, suggesting that the two gender groups varied significantly in terms of the dependent variables. Post-comparison revealed that the students in grade 9 differed from those in grade 10, and the mean scores indicated that the grade 9 students had lower scores compared to the grade 10 students.

Nevertheless, the mean aspiration scores increased after STEM lessons for female students, while they remained unchanged for male students, as indicated in the table. Even though the girls had increased interest and science aspirations than the boys, many studies found out that the Gender difference in STEM can be reduced if female student participate in STEM in many with different ways

and get role- model mentoring (Bottia et al., 2015; Christensen et al., 2014; Ozis et al., 2018; Stoeger et al., 2017). To increase boys' learning and participation in STEM areas, the following strategies can be adopted, including giving them extra prizes and offering extra points and grades. They can also be motivated by endorsing them to appealing STEM activities that incorporate play.

Thus, it is providing the scientific evidence for other investigations which revealed the gap of genders in STEM disciplines and went along with those essays which underline that STEM lessons that give girls the experience of what real STEM careers is like can effectively reduce the gap between male and female students' interest in STEM education (Patterson et al., 2021).

As established earlier, the participation of women in STEM careers is significantly lower compared to that of men; however, considerable potential exists to reduce this gender disparity, as indicated by some research. Several promising strategies exist that colleges and universities can employ to mitigate STEM setbacks among male students. These initiatives include increasing female students' enrollment in STEM fields at all levels of education and pairing female mentors with male students (Reinking & Martin, 2018; Wang & Degol, 2017; Xu, 2015).

As suggested in other studies and supported by the findings of the present study, there is a clear indication that women are underrepresented in STEM careers. In addition, research conducted within this study reveals that girls can advance towards STEM employment by attending STEM training programs that teach them this approach, which offers hands-on experience and challenges students to solve real-life scenarios. It therefore establishes that Positive Outcome Expectations fit under the category of interest and choice in SCCT. With regard to these findings, it may be hypothesized that where students' self-efficacies are high, their interest in working in school will be higher. Thus, on the balance of probability, school outcomes can conceivably be said to harbor favorable expectations. The conclusion section of this study also confirms this discussion by providing a summary of the research study on the concern of gender and grade levels in determining STEM career choices. Consequently, the research findings revealed that there is a statically significant difference in the mean aspiration scores of the female and the male students. The results support the ontological assertions on the eradication of gender differences that surface due to girls weirding into STEM lessons, as described in the literature by Bottia et al., (2015), Christensen et al., (2014), and Ozis et al., (2018). This aligns with the findings that the differences in STEM interest and foresight are significantly more pronounced between male and female students, with most effect sizes being moderate across various fields of science, technology, engineering, and mathematics. g., science: Partial eta square = 0.07).

Grade level also played a crucial role, with tenth graders showing higher interest and aspirations than ninth graders, reflecting the statistically significant differences observed (e.g., science: Effect size: Partial eta squared = 0.02). In other words, students' involvement and appreciation of STEM professions increase as they progress through school, a pattern similar to that observed in prior research on the necessity of maintaining STEM learning during the high school years (Patterson et al., 2021). The strong positive correlations between STEM interest and career aspirations (science: science ($r = 1.00$), technology ($r = 0.86$), engineering ($r = 0.61$), mathematics. The indicated cross-domain predictors of career interests in STEM fields support the need to engage students with real-life STEM experiences, which aligns with prior research by Kitchen et al. (2018) and Means et al. (2016). It also highlights the importance of leadership and quality in STEM education, noting that the effectiveness of good STEM education relies on leaders, as highlighted by Averill (2018) and Wang et al. (2011). The study's results showing significant predictors of career aspirations (e.g., science: In general, it was found that the level of STEM was appreciable, $b = 0.94$; technology, $b = 0.82$; engineering, $b = 0.93$; mathematics, $b = 0.84$) These results justify the demands for quality STEM programs delivered by enthusiastic teachers.

Lastly, the findings discussed in the paper corroborate the assertion of the Social Cognitive Career Theory (SCCT), which explains career interests and choices based on perceived self-efficacy and an accurate perception of the likely outcome. The major predictors and the total model endorsement support SCCT's components. Furthermore, they show how practical experiences and positive expectations enhance interest and aspiration toward STEM careers. These findings underscore the need for gender-specific interventions to improve interest and engagement in STEM for girls, as well as the need to ensure that ninth-grade students' participation is sustained through successive grades.

6. Conclusion, Recommendations, and Limitations

6.1. Conclusion

The study examines the impact of STEM education on the career aspirations of ninth and tenth graders in Al Fujairah, United Arab Emirates. The findings showed that students' enthusiasm for pursuing future careers in science, technology, engineering, and mathematics was highly impacted by their exposure to STEM education. Students' STEM career choices were strongly predicted by their enthusiasm for science, particularly highlighting the value of involving students in these areas at an early age.

Since the research was conducted in a single region using convenience sampling, the findings should be interpreted cautiously and not generalized beyond the studied population. However, the study provides valuable insights for educators and policymakers seeking to develop targeted programs that encourage students to pursue STEM-related careers. Extending such studies to other areas of the UAE with more representative samples would increase our understanding of how STEM education affects students' career goals nationwide.

6.2. Recommendations

These studies underscore the need for additional research to investigate the challenges associated with STEM integration. A comparative analysis would expand knowledge of the connection between participation in STEM classes and the shift in children's careers and aspirations to specialize in STEM fields. A comparison of STEM fields is a recommended area for further study.

Future studies may include elementary and secondary school students as well as those attending different types of schools in UAE and around the world. The inclusion of diverse communities from various age groups, socioeconomic backgrounds, and cultural heritages should be the primary goal of this expansion.

The data obtained for this study involved middle- and high-school students from the UAE. If data from students in the UAE and/or other countries were incorporated into the analysis, it would be possible to determine whether STEM classes in general could provide the same results as in the current study.

This study supports the fact that the evaluation of literature revealed the existence of a gender disparity in STEM disciplines that places more emphasis on males; however, the gap could be closed in the case of girls engaging in STEM-type programs.

For students to be engaged meaningfully and at the highest level, practice-based high-quality teaching should be underpinned by a structured, realistic curriculum, clear expectations, and other forms of assessment as appropriate to the learning capacities of UAE students.

Technology-enhanced strategies for thinking, playing, collaborating, and communicating that make students and educators more interested in STEM activities can be further developed by applying the suggested method for enhancing students' actual encounters with STEM ideas and

concepts. Particularly, students in middle and high school need experience in handling laboratory environments. In the same regard, there is a need to promote inquiry learning and learning through scientific fairs for K–12, contests throughout all K–12 education levels, project-based individualized learning, and community-based learning both in and out of the classroom.

This strategy may involve the use of psychometric approaches to longitudinally track changes in students' perceptions and engagement in STEM disciplines, as well as research on the contextual antecedents of students' engagement.

6.3. Limitations

Using statistical methods (such as regression, MANOVA, and Pearson correlation), the convenience sampling method limits the generalizability of the results. It is essential to understand that the findings are specific to the group under study and shouldn't be generalized to all students in the United Arab Emirates. At the same time, the findings cannot be applied to other Emirates or foreign environments because they were limited to Al Fujairah. These restrictions emphasize that, although the results offer insightful information about the setting under study, they should be evaluated with caution.

Declarations

Author Contributions. Manal Almahdawi: Corresponding author, literature review, create tools for research, data collection; Ahmad Qablan: Editing, and manuscript preparation, methodology, and critical revisions; Fatema Alyammahi: Conceptualization, methodology, data analysis, and validation. All authors have read and approved the final version of the article for publication.

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Data Availability Statement. The data supporting the results reported in this study are available from the corresponding author upon reasonable request.

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References

- Al Basha, H. A. (2018). Investigating Teachers' Perceptions and Implementation of STEM Education in the United Arab Emirates. *The British University in Dubai (BUiD)*
- Al Murshidi, G. (2019). STEM Education in the United Arab Emirates: Challenges and Possibilities. *International Journal of Learning, Teaching and Educational Research*, 316-332. <https://doi.org/10.26803/ijlter.18.12.18>
- Altoum, R. (2021). Relationship Between Attending STEM Extracurricular Programs and Aspiration Toward STEM Careers (Doctoral dissertation, Walden University).
- Averill, C. L. (2018). Perceptions of K-8 Building Administrators and Classroom Teachers on STEM Implementation within a Catholic Diocese in the Southeastern Region of the US (Doctoral dissertation, The George Washington University). Retrieved from <https://eric.ed.gov/?id=ED588935>.
- Bryman, A. (2011). Research methods within this study of leadership. *Leadership*, 7(1), 73-83.

- Bottia, M. C., Stearns, E., Mickelson, R. A., Moller, S., & Valentino, L. (2015). Growing the roots of STEM majors: Female math and science high school faculty and the participation of students in STEM. *Economics of Education Review*, 45, 14-27. <https://doi.org/10.1016/j.econedurev.2015.01.002>
- Bottia, M. C., Stearns, E., Mickelson, R. A., & Moller, S. (2018). Boosting the numbers of STEM majors? The role of high schools with a STEM program. *Science Education*, 102(1), 85-107. <https://doi.org/10.1002/sce.21318>
- Cairns, D., & Dickson, M. (2021). Exploring the relationships between gender, science dispositions, and science achievement in STEM career aspirations among adolescents in public schools in the UAE. *The Asia-Pacific Education Researcher*, 30(2), 153-165. <https://doi.org/10.1007/s40299-020-00522-0>
- Carpi, A., Ronan, D. M., Falconer, H. M., & Lents, N. H. (2017). Cultivating minority scientists: Undergraduate research increases self-efficacy and career ambitions for underrepresented students in STEM. *Journal of Research in Science Teaching*, 54(2), 169-194. Retrieved from <https://onlinelibrary.wiley.com/doi/pdf/10.1002/tea.21341>.
- Christensen, R., Knezek, G., Tyler-Wood, T., & Gibson, D. (2014). Longitudinal analysis of cognitive constructs fostered by STEM activities for middle school students. *Knowledge Management & E-Learning*, 6(2), 103.
- Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications. Dawson, T. E. (1997). A primer on experimental and quasi-experimental design. *Austin, TX: Annual Meeting of the Southwest Educational Research Association*. (ERIC Document Reproduction Service No. ED406440).
- English, L. D. (2016). STEM education K-12: Perspectives on integration. *International Journal of STEM education*, 3(1), 1-8. Retrieved from <https://link.springer.com/article/10.1186/s40594-016-0036-1>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling *American journal of theoretical and applied statistics*, 5(1), 1-4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review*, 31(1), 2-24. <https://doi.org/10.1108/eb-11-2018-0203>
- Huziak-Clark, T., Sondergeld, T., van Staaden, M., Knaggs, C., & Bullerjahn, A. (2015). Assessing the impact of a Research-Based STEM program on STEM majors' attitudes and beliefs. *School Science and Mathematics*, 115(5), 226-236. <https://doi.org/10.1111/ssm.12118>
- Kelly, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, 3(11). <https://doi.org/10.1186/s40594-016-0046-z>.
- Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2013). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education*, 44(3), 461-481. <https://doi.org/10.1007/s11165-013-9389-3>
- Kitchen, J. A., Sonnert, G., & Sadler, P. M. (2018). The impact of college- and university-run high school summer programs on students' end of high school STEM career aspirations. *Science Education*, 102(3), 529-547. <https://doi.org/10.1002/sce.21332>
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice and performance. *Journal of Vocational Behavior*, 45(1), 79-122. <https://doi.org/10.1006/jvbe.1994.1027>

- Madani, R. A. (2020). Teaching Challenges and Perceptions on STEM Implementation for Schools in Saudi Arabia. *European Journal of STEM Education*, 5(1), 3. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1265301.pdf>
- Makhmasi, S. S., Rachad, B. H., & Al-Hammadi, Y. (2012). Factors Influencing STEM Teachers' Effectiveness in the UAE. *2012 Frontiers in Education Conference Proceedings*. <https://doi.org/10.1109/FIE.2012.6462396>.
- Makransky, G., Petersen, G. B., & Klingenberg, S. (2020). Can an immersive virtual reality simulation increase students' interest and career aspirations in science? *British Journal of Educational Technology*, 51(6), 2079-2097. Retrieved from <https://psyarxiv.com/2qrs3/download?format=pdf>
- Mallinson, C., & Charity Hudley, A. H. (2014). Partnering through science: developing linguistic insight to address educational inequality for culturally and linguistically diverse students in u.s. Stem education. *Language and Linguistics Compass*, 8(1), 11-23. Retrieved from <https://doi.org/10.1111/lnc3.12060>
- Means, B., Wang, H., Young, V., Peters, V. L., & Lynch, S. J. (2016). STEM-focused high schools as a strategy for enhancing readiness for postsecondary STEM programs. *Journal of Research in Science Teaching*, 53(5), 709-736. <https://doi.org/10.1002/tea.21313>
- Nite, S. B., Capraro, M. M., Capraro, R. M., & Bicer, A. (2017). Explicating the Characteristics of STEM Teaching and Learning: A Meta-Synthesis. *Journal of STEM Teacher Education*, 52(1), 6.
- Ozis, F., Pektas, A. O., Akca, M., & DeVoss, D. L. A. (2018). How to shape attitudes toward STEM careers: The search for the most impactful extracurricular clubs. *Journal of Pre-College Engineering Education Research (J-PEER)*, 8(1), 3. <https://doi.org/10.7771/2157-9288.1192>
- Patterson, L., Varadarajan, D. S., & Saji Salim, B. (2021). Women in STEM/SET: gender gap research review of the United Arab Emirates (UAE)—a meta-analysis. *Gender in Management: An International Journal*, 36(8), 881-911. Retrieved from <https://doi.org/10.1108/gm-11-2019-0201>
- Phelps, J., Sanati-Nezhad, A., Ungrin, M., Duncan, N. A., & Sen, A. (2018). Bioprocessing of mesenchymal stem cells and their derivatives: toward cell-free therapeutics. *Stem Cells International*, 2018. <https://doi.org/10.1155/2018/9415367>
- Qablan, A. (2021). Assessing Teachers' Education and Professional Development Needs to Implement STEM after Participating in an Intensive Summer Professional Development Program: Teacher Professional Development and STEM. *Journal of STEM Education: Innovations and Research*, 22(2)
- Reinking, A., & Martin, B. (2018). The gender gap in STEM fields: Theories, movements, and ideas to engage girls in STEM. <https://doi.org/10.7821/naer.2018.7.271>
- Rogers, K., Dziobek, I., Hassenstab, J., Wolf, O. T., & Convit, A. (2007). Who cares? Revisiting empathy in Asperger syndrome. *Journal of autism and developmental disorders*, 37, 709-715. <https://doi.org/10.1007/s10803-006-0197-8>
- Rockland, K. S. (2010). Five points on columns. *Frontiers in Neuroanatomy*, 4, 1485. <https://doi.org/10.3389/fnana.2010.00022>
- Scott, W. R. (2012). Group theory. Courier Corporation.
- Seedhouse, P. (2005). Conversation analysis as research methodology. Applying conversation analysis, 251-266. https://doi.org/10.1057/9780230287853_15

- Sellami, A., Ammar, M., & Ahmad, Z. (2022). Exploring teachers' perceptions of the barriers to teaching STEM in high schools in Qatar. *Sustainability*, 14(22), 15192. Retrieved from <https://www.mdpi.com/2071-1050/14/22/15192>
- Shaer, S., Zakzak, L., & Shibl, E. (2019). The STEAM dilemma: Advancing sciences in UAE schools – the case of dubai. United Arab Emirates: Mohammed Bin Rashid School of Government (MBRSG). Retrieved from <https://www.mbrsg.ae/getattachment/174c88b2-e633-4dc9-9f9a-a473f6c91892/The-STEAMDilemma-Advancing-Sciences-in-UAE-School.aspx>
- Stoeger, H., Hopp, M., & Ziegler, A. (2017). Online mentoring as an extracurricular measure to encourage talented girls in STEM (science, technology, engineering, and mathematics): An empirical study of one-on-one versus group mentoring. *Gifted Child Quarterly*, 61(3), 239-249. <https://doi.org/10.1177/0016986217702215>
- Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Pearson
- Thibaut, L., Ceuppens, S., De Loof, H., De Meester, J., Goovaerts, L., Struyf, A., & Depaepe, F. (2018). Integrated STEM education: A systematic review of instructional practices in secondary education. *European Journal of STEM Education*, 3(1), 2. <https://doi.org/10.20897/ejsteme/85525>
- Wang, H. H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM integration: Teacher perceptions and practice. *Journal of Pre-College Engineering Education Research (J-PEER)*, 1(2), 2.
- Wickens, K., Barthow, C., Mitchell, E. A., Kang, J., van Zyl, N., Purdie, G., & Crane, J. (2018). Effects of *Lactobacillus rhamnosus* HN001 in early life on the cumulative prevalence of allergic disease to 11 years. *Pediatric Allergy and Immunology*, 29(8), 808-814. <https://doi.org/10.1111/pai.12982>
- Xu, K., Ba, J., Kiros, R., Cho, K., Courville, A., Salakhudinov, R., & Bengio, Y. (2015, June). Show, attend and tell: Neural image caption generation with visual attention. *In International conference on machine learning (pp. 2048-2057)*. PMLR.
- Young, J. R., Ortiz, N., & Young, J. L. (2017). STEMulating interest: A meta-analysis of the effects of out-of-school time on student STEM interest. *International Journal of Education in Mathematics, Science and Technology*, 5(1), 62-74. <https://doi.org/10.18404/ijemst.61149>

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