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Author for correspondence:
Othman Abu Khurma
othman.abukhurma@ecae.ac.ae
Emirates College for Advanced Education, Abu Dubai, UAE

Digital Skills and Science Achievement: Analyzing Socio-Economic Factors and Learning Views

Nagla Ali, Othman Abu Khurma, Khadeegha Alzouebi, Adeeb Jarrah, Myint Swe Khine, Fayrouz Albahti, Qasim AlShannag

Abstract

Background/purpose. Science education has gained more prominence as a means of educating students for the demands of a technologically evolved world. Understanding the variables influencing students' science achievement is vital for educational policymakers and practitioners.

Materials/methods. The study used a hierarchical multiple regression analysis method to study data from the 2019 iteration of TIMSS, in which 5728 eighth-grade students from Dubai in the United Arab Emirates (UAE) participated. It examined the links between socioeconomic status (SES), computer self-efficacy, conceptions of learning science (like learning science, instructional clarity in science lessons, confidence in science, and valuing science), and science achievement.

Results. It was found that the associations between student age, socioeconomic status, computer self-efficacy, conceptions of learning science, and science achievement are significant.

Conclusion. Policymakers and educators should adopt effective strategies to reduce socioeconomic disparity amongst students, enhance conceptions of learning science, and improve students' computer self-efficacy.

1. Introduction

Science education is essential in preparing students to deal with the demands of a technological world. As a city renowned for its development and advancement, Dubai primarily focused on advancing science education to complement its overall economic and strategic aspirations (Areepattamannil, 2024). Improved insight into the key factors that lead to students' science achievements is thus necessary for education policymakers and professionals in Dubai.

Past research highlights that the beliefs of the students toward learning science and computer self-efficacy have a significant impact on the academic performance of the students in science (Jufrida et al., 2019a; Liu et al., 2020; Schunk & DiBenedetto, 2021). The students' beliefs in learning science decide the learning conditions, attitudes, and learning strategies that the students use. For instance, students who believe that learning science is a process of understanding and application rather than mere memorization perform better, as indicated by Jufrida et al. (2019b). Students who believe science is relevant to real life also possess more intrinsically motivated behavior that aligns with better academic performance (Ryan & Deci, 2020). Similarly, instructional clarity, the capability of the teachers to explain scientific concepts clearly—has also been highlighted as a means of improving the conceptual understanding and participation of the students in science lessons.

Apart from learning science concepts, computer self-efficacy, a belief in one's ability to effectively utilize digital technology—remains a highly predictive indicator of academic performance (Zimmerman & Kulikowich, 2016). Wang and Zheng (2020) demonstrated in a study that students with high computer self-efficacy will be more likely to engage with online learning environments, try online science simulations, and create independent problem-solving skills. Equally, Schunk and Zimmerman (2023) demonstrated how students who believe in utilizing digital technology proficiently display higher self-regulated learning, a tremendous predicting measure for science success. With technology continuing to permeate the classroom in general, most profoundly in STEM classrooms, digital literacy is a significant component of student success (Ertmer & Ottenbreit-Leftwich, 2020).

Furthermore, SES is among the most studied predictors of students' achievement in various learning environments (OECD, 2021). Advantaged SES students have more benefits, such as better learning resources, more support from parents, and out-of-school learning opportunities, all of which increase achievement (Sirin, 2005). Disadvantaged SES students have fewer resources, such as fewer computers and less parental support, which negatively contribute to science achievement (Evans et al., 2020). There exist reported interactions between SES, computer self-efficacy, and achievement, but none of the studies investigated how the determinants influence science achievement among Dubai eighth graders.

To address this research gap, the current study applies hierarchical multiple regression analysis to investigate the inter-relationship among SES, computer self-efficacy, and science learning concepts such as "learning science, instructional clarity in science lessons, confidence in science, and valuing science" and determine the predictive capacity of such concepts to science achievement. By determining the most important predictors of science achievement, the current study aims to provide valuable information that enhances the learning process in Dubai and guides teaching practices to facilitate science learning in the UAE.

2. Literature Review

The importance of learning science lies in its vital goal of serving current technologically advanced societies, therefore, understanding and analyzing the fundamental aspects affecting students' learning processes (and learning how to learn) and learning results to improve science achievement, given that science achievement is the ultimate purpose reflect the knowledge, skills,

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and attitudes. The concepts of socioeconomic status, conceptions of learning science, computer self-efficacy, and their effects on science achievement are covered in this section.

2.1. Socio-economic status (SES)

Socioeconomic status (SES) has been identified as a critical aspect in influencing students' achievements, especially in science subjects. The relationship between science achievement and socioeconomic status is verified and confirmed by evidence. It provides various ways socioeconomic status influences science-student learning (Nguyen & Riegle-Crumb, 2021). Researchers found that science students from more affluent classes perform better than science students from less affluent classes in the science class (Brockhouse, 2019).

The science achievement gap is explainable by socioeconomic variables that include parents' educational background, family background, family income, family resources (both material and soft resources), and educational opportunity. Economic resources and income, among other factors, contribute to science achievement. Students from more affluent homes often have access to more learning and development resources, such as the availability of advanced technology (for example, augmented reality and virtual labs in science) and the provision of support materials (Burroughs et al., 2019). These tools can boost students' learning on science-related assessments by deepening their understanding and enthusiasm for the subject topics, ideas, and scientific concepts.

A substantial correlation between socioeconomic status and academic achievement has been found in studies using the Trends in International Mathematics and Science Study (TIMSS) assessment data repeatedly, this includes both school grades targeted by TIMSS, fourth and eighth-grade students. In both mathematics and science, students from more affluent socioeconomic backgrounds typically perform better than their less affluent counterparts (Reardon et al., 2016). The accessibility of instructional tools and assistance is a vital variable. Families from higher socioeconomic statuses frequently have more money to spend on supplementary educational resources and create an environment that fosters student learning (Broer et al., 2019a), that has better resources, quality information from credible resources, and in some cases, expert tutors dedicated to this special few of students, unlike those who would be attending crowded lessons to get an education.

Additionally, parents with higher education levels and professional vocations may have a deeper understanding of academic topics, enabling them to offer their children better educational advice and support at home (Wiberg, 2019). Providing a suitable environment, support materials, and other resources is thus found to improve science accomplishment outcomes by providing a proper setting, support materials, and other resources.

2.2. Conceptions of Learning Science

Conceptions of science learning are a person's attitude, convictions, and ideas about what science learning entails and what elements support effective learning. Conceptions of science learning are important to encourage self-regulated learning, leading to improved learning outcomes. According to Velayutham and Aldridge (2012), one of the objectives of scientific instruction is to empower and motivate students by increasing their confidence in their ability to succeed in science learning and developing the self-regulatory skills necessary for success (Abu Khurma et al., 2022). The students' conceptions of science learning allow them to understand their motivation and ability to engage in science learning and predict learning outcomes. TIMSS measures students' conception of learning science with the following scales: 1) Like learning science; 2) Science instructional clarity; 3) Confidence in science; and 4) Valuing science.

Learning science is the conception of liking the science learning process and looking forward to the learning sessions (Jufrida et al., 2019b). Students' interest in and liking of learning science and not finding it boring are considered to encourage them to engage in the lessons, which in turn is expected to lead to better learning outcomes (Broer et al., 2019b). Clarity in science instruction refers to how teachers explain the subject to students, dramatically impacting how well students learn (Yagan, 2021). In the TIMSS, students are questioned about many aspects of their instructors' instruction during their science lessons, including whether or not they comprehend what their teachers expect them to do and whether or not their teachers are simple to grasp, provide clear answers to their questions, and are adept at communicating science (Peciuliauskiene, 2022). Having higher clarity of instruction is found to enhance student understanding and academic achievement (Chen & Lu, 2022; Teig & Nilsen, 2022).

Confidence in science refers to students' confidence in learning and performing well in science subjects. TIMSS measures confidence by whether students think they do well in science, whether they get confused, and if they can solve complex problems, among other aspects. Confidence leads to positive conceptions and enhances students' abilities to learn science, resulting in better achievements (Balfaqeeh et al., 2022). Valuing science refers to students understanding the usefulness of science learning in their daily lives and allowing them to get jobs in the future. Valuing science is an insightful measure of science learning as students who value science and consider it useful engage in deeper learning and fare better in science subjects (Awang et al., 2021). Berger et al. (2020) noted that students who have enhanced intrinsic value of science put extra effort into science learning and have higher science achievement.

2.3. Computer Self-efficacy

Computer self-efficacy refers to an individual's belief in their ability to effectively use and perform tasks on a computer. It involves confidence in one's ability to navigate computer software, hardware, and the internet. Computer self-efficacy can influence how individuals approach computer-related tasks, selecting which computer-based challenge to invest time-solving or give up, such as learning new software or troubleshooting technical issues. Higher levels of computer self-efficacy are often associated with increased productivity, as it may indicate someone's non-interrupted learning tasks, a greater willingness to adopt new technologies, and more positive attitudes toward learning, not to mention an extended exposure to complicated learning software (Torres et al., 2022). Most learning resources available are computer-based as they are published or shared by web resources or even as a soft copy shared by teachers. Knowing how to retrieve and select relevant materials is essential for students and positively impacts their learning (Hatlevik et al., 2018). Individuals with higher levels of computer self-efficacy may be more likely to seek out and engage with technology-related opportunities, such as searching online learning materials and the ability to review and understand experts' comments on learning software, which positively impacts science achievement (Abdullah & Mustafa, 2019).

2.4. Conceptual Framework

Science achievement has been defined by TIMSS assessment as the demonstrated knowledge by students, the performed skills, their attitudes, and comprehension of scientific concepts and science processes that include basic and integrated skills. The TIMSS definition includes an assessment of student's achievement in science and mathematics. Also, it evaluates how well students succeed in many disciplines and provides valid and reliable information on how well they understand and improve their scientific knowledge. It is drawn as a conclusion supported by evidence and abilities through a series of questions covering all thinking skill levels. Students' performance on a standardized science test used in the TIMSS program is evaluated regarding how well they can apply their knowledge in other contexts, carry out scientific experiments, analyze scientific data, provide interpretations, and draw scientific claims that are supported by the elicited evidence (Zhang & Bae, 2020). The test covers a variety of areas. The questions are chosen in such a way that they would assess the level at which the students understand scientific principles and concepts, their application level of logic and problem skills from the scientific method, and their level of acquaintance with these methods, leading them towards their acquaintance in the science concept (Chen & Hastedt, 2022). As science knowledge and education are given increased importance in meeting the modern-day needs of societies, the factors and aspects affecting students' science achievement are assessed and understood to determine how students can be supported in enhancing their science learning.

Socioeconomic status is a key factor affecting students' outcomes since socioeconomic status affects their resources and support system (Harju-Luukkainen et al., 2020). Children's developmental circumstances, academic success, and socioeconomic level (SES) influence their science performance (Broer et al., 2019a). Students from more affluent socioeconomic backgrounds often outperform their less wealthy peers in science, as confirmed by Reardon et al. (2016). A key factor is the availability of educational resources and support. Higher socioeconomic status families usually have more money to invest in extracurricular learning materials and fostering a learning environment for students (Broer et al., 2019a).

The term "conceptions of learning" refers to a person's inherently held theory or interpretation of the learning process. How learners view the educational process reflects how their brains direct learning (Han & Ellis, 2019). It is important since it concerns learners' learning styles (deep vs. surface). As a result, different learners frequently have various ideas of learning science, and their learning experiences and preferred learning techniques also play a role in developing these concepts (Cai et al., 2018). This will ultimately impact their performance in science.

Another factor that is found to impact science achievement is computer self-efficacy. An individual's confidence in their capacity to successfully use and carry out computer-related tasks is called computer self-efficacy (Kolil et al., 2020). The ability to use computer hardware, software, and the internet confidently is required for effective learning. Higher levels of computer self-efficacy are frequently linked to higher levels of learning since more optimistic learning attitudes are associated with computer technology. The vast majority of learning resources are computer-based. Students benefit from having the ability to locate and choose pertinent content since it enhances their learning (Aboderin & Laleye, 2019). Higher computer self-efficacy may make people more open to and engaged in technology-related opportunities, such as looking for online learning resources that improve science achievement.

Based on the above discussion, the conceptual framework developed for the study is presented in Figure 1.

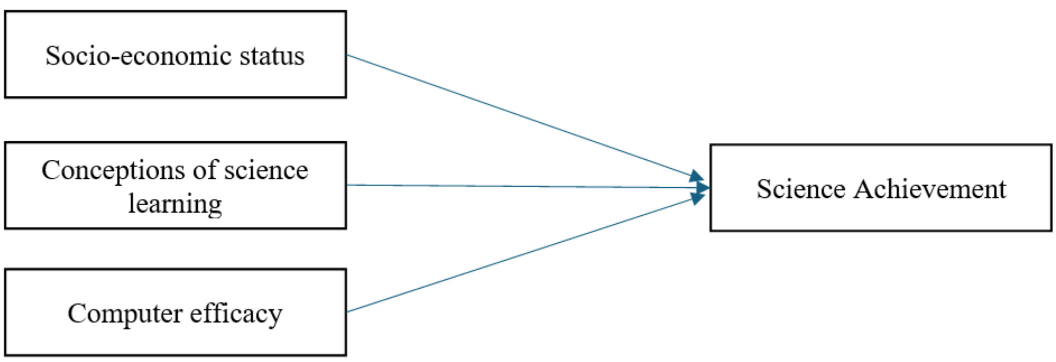

Figure 1. Conceptual Model for the Current Study

Figure 1 displays the conceptual model of the current study, with interrelations between socioeconomic status (SES), conceptions of science learning, computer self-efficacy, and science achievement. SES is highly documented to significantly impact academic performance, with

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ramifications for access to learning opportunities and resources. Conceptions of learning science, including instructional clarity, confidence in science, and valuing science, have impacts on engagement and performance. Computer self-efficacy is also a significant academic performance predictor since learners have more confidence in using computers, utilizing digital learning material, and practicing effective learning strategies.

2.5. Problem Statement

Finally, the study investigated the relationships between socioeconomic status (SES), computer self-efficacy (CS), conceptions of learning science (CLS), and science achievement among eighth-grade students in Dubai, UAE. Despite growing interest in these factors, little is known about how they collectively interact to predict science achievement. Based on this, the study examines the links between socioeconomic status SES, computer self-efficacy CS, conceptions of learning science CLS (like learning science, instructional clarity, confidence in science, and valuing science), and science achievement. Links here clarify how these variables (SES, CS, and CLS) predict science achievement for eighth-grade students. For this aim, the study formulated the following research questions.

2.6. Research Questions

This study explored the associations between conceptions of learning science, computer self-efficacy, and science achievement among eighth-grade students in Dubai in the United Arab Emirates using Hierarchical multiple regression analysis. The following are the research questions:

1. What are the associations between conceptions of learning science and science achievement among grade eight students in Dubai?

2. What is the significant prediction of science achievement by conceptions of learning science, socioeconomic status, and computer self-efficacy?

3. Methodology

3.1. General Background

The research design is a quantitative, secondary data analysis focusing on identifying patterns and trends in student performance. The study was conducted by analyzing the secondary data of TIMSS for the most recent available cycle, 2019. The research approach is exploratory, utilizing statistical methods to investigate the correlational relationship between various factors affecting student achievement in Dubai. The theoretical framework draws on educational theories related to academic performance and cross-cultural comparisons.

3.2. Sample Selection

The sample comprises grade eight students from Dubai in the United Arab Emirates, drawn TIMSS. This international large-scale assessment program monitors students' academic performance trends in mathematics, science, and reading. The research sample includes diverse school populations, with data on science achievement and demographic factors like gender and socioeconomic status. Since its inception in 1995, TIMSS has been regularly administered. In 2019, 64 countries and eight benchmarking entities participated in the study, representing various geographic regions and educational systems worldwide. In the 2019 iteration of TIMSS, 5728 eighth-grade students from Dubai, United Arab Emirates, participated (KHDA - Resources on Education in Dubai, 2022).

3.3. Instrument and Procedures

The research used secondary data publicly available from the TIMSS database, which includes standardized assessments of the 2019 iteration of TIMSS, 5728 eighth-grade students from Dubai, United Arab Emirates, participated (KHDA - Resources on Education in Dubai, 2022) student achievement in mathematics and science. The tool used to collect the data was the student questionnaire; it provides comprehensive, reliable data on academic performance, demographic variables, and contextual factors influencing achievement.

3.4. Socio-economic status (SES)

The Social-Economic Status (SES) was used with question items indicating the procession of home educational resources in the TIMSS. The variables include (i) a desk or table where the student could study or do homework, (ii) adequate lighting in the room where the student studied, (iii) access to a computer or tablet for schoolwork, (iv) access to the internet for schoolwork, (v) dictionary in the language of instruction, and (vi) reference books, such as an atlas or encyclopedia (Yin et al., 2023).

3.5. Conceptions of science learning

The conceptions of science learning refer to an individual's attitude, beliefs, and ideas about what science learning is and what factors contribute to successful learning. The students' conception of science learning was measured in four dimensions. These were (i) like learning science, (ii) instructional clarity in science lessons, (iii) confidence in science, and (iv) valuing science. The students answer on a 4-point Likert scale ranging from agree a lot, agree a little, disagree a little, and disagree a lot. Sample items measuring the extent to which students like science learning include "I look forward to learning science in school." A sample item to measure a student's confidence is "I am confident that I can solve science problems on my own."

3.6. Computer Self-efficacy

Fifteen questions measured self-efficacy for computer use in TIMSS. These questions assess the students' communication competencies, problem-solving, and information technology usage. A sample question in assessing self-efficacy in computers is, "I can use a computer to prepare a presentation." The students answer on a 4-point Likert scale ranging from agree a lot, agree a little, disagree a little, and disagree a lot. Other items assess to what extent the students know the meaning of the computer-related terms such as 'WiFi" and "Icon." The students answer on a 4-point Likert scale ranging from very well, well, a little, and not at all.

3.7. Science achievement

The TIMSS science is intended to measure scientific content knowledge and principles and their application in solving real-life problems by the students. The assessment is in the form of multiple-choice and extended-answer questions and is given to a sample population from each country participating in the study. The TIMSS science score ranges from 0 to 1000, with higher scores indicating better performance. The average science score for all countries participating in TIMSS is 500, with a standard deviation of 100. Approximately two-thirds of students from participating countries can expect to score between 400 and 600 on the science test. As a measure of achievement, the study provides five plausible values, and this study used the first plausible value (Martin et al., 2019).

3.8. Data Analysis

In the present study, data were screened for missing responses and outliers. Preliminary studies were performed to confirm that the normalcy assumptions were not violated. Table 1 reports that skewness values ranged from -.510 to .600, and kurtosis values ranged from -.786 to .402, indicating support for the items' univariate normality (Velayutham, 2012). Hierarchical multiple regression was conducted with SPSS version 27 (George & Mallery, 2021) for the Dubai sample to identify the constructs predicting science achievement. The Hierarchical multiple regression was used to examine how the following variables—socioeconomic status, computer self-efficacy, and conceptions of science learning—predict the variable "science achievement." Variables were entered in a stepwise manner: socio-economic status first, followed by computer self-efficacy, and then conceptions of science learning. This approach allowed us, the authors, in consultation with the data analyst, to assess the unique contribution of each predictor while controlling the effects of others to get a clearer understanding of their impact on science achievement.

Table 1. Mean, Standard Deviation, Skewness, and Kurtosis of the Latent Constructs

Variables	Mean	Standard deviation SDσ	Skewness	Kurtosis
Socio-economic status	**10.68**	**1.43**	**-0.23**	**0.30**
Like learning science	10.60	2.01	0.01	-0.78
Instructional clarity	10.37	1.91	-0.47	-0.30
Confidence in science	10.51	2.00	0.60	0.40
Valuing science	10.69	1.79	-0.40	-0.27
Computer self-efficacy	10.52	1.75	-0.51	-0.07

The variance inflation factor (VIF) measures the degree of multicollinearity within a regression model. Multicollinearity arises when two or more predictor variables in a regression model are highly correlated, resulting in issues with the stability and interpretability of the regression coefficients. A VIF of 1 suggests no correlation between the model's predictor variable and other predictor variables. Typically, a VIF greater than 1.5 or 2 indicates significant multicollinearity, although the exact threshold for concern may vary depending on the context and goals of the analysis. In this study, the VIFs of the independent variables ranged from 1.05 to 1.97, indicating that there were no problems with multicollinearity. A VIF of less than 10 is typically a favorable range for multicollinearity (Field, 2017). The Durbin-Watson statistics are applied to test for autocorrelation in a dataset, that is, autocorrelation among the residuals in a regression model. The range for the Durbin-Watson statistics is study problem, type, and purpose-dependent. Generally, a level of about 2 for the Durbin-Watson statistic is acceptable, indicating no significant autocorrelation in the data. In this study, the Durbin-Watson coefficient (d) was 1.15, indicating that there was no problem with autocorrelation in the data (Kabaila et al., 2020).

4. Results

The Pearson product-moment correlation coefficient calculated correlations between science achievement and Socioeconomic status, like learning science, instructional clarity, science confidence, valuing science, and computer self-efficacy. Table 2, for example, reflects a relationship between science achievement and home resources, like learning science, instructional clarity, science confidence, valuing science, and computer self-efficacy. However, there is no relationship between gender and science achievement. Additionally, instructional clarity is positively associated with confidence in science, valuing science, and computer self-efficacy. Table 2 shows the correlation coefficients among variables.

Table 2. Correlation among variables

Variables	1	2	3	4	5	6	7	8	9
1 Science achievement	1								
2 Gender	-.016	1							
3 Age	.091***	.015	1						
4 Socio-economic status	.307***	-.019	-.008	1					
5 Like learning science	.244***	.019	-.002	.094***	1				
6 Instructional clarity	.093***	-.013	-.057***	.051	.581	1			
7 Confidence in science	.288***	.037	-.037**	.152	.682	.479***	1		
8 Valuing science	.157***	.029	-.004	.081	.621	.474***	.486***	1	
9 Computer self-efficacy	.259***	-.014	.029*	.199	.161	.162***	.216***	.139***	1

*p<.05, **p<.01, ***p<.001

The highest-level relationship was found between science achievement and socioeconomic status. Computer self-efficacy was also found to be highly correlated with science achievement. Another relationship between confidence in science and science achievement is found to be highly significant. Conceptions about science learning and computer self-efficacy are generally correlated with science achievement, and the relationship is statistically significant at $p < .001$ level.

Hierarchical multiple regression is a statistical method used to analyze the association between a dependent variable and several independent variables while adjusting for the effects of other variables. The purpose of hierarchical multiple regression is to explore how adding variables to a regression model can improve the prediction of the dependent variable. Hierarchical multiple regression was employed in this study to evaluate the efficacy of seven control measures (students' age, human resources, computer self-efficacy, valuing science, confidence in science, like learning science, and instructional clarity) to predict science achievement.

Table 3. Hierarchical multiple regression analysis for science achievement

Predictors	*R*	R^2	ΔR^2	*F*	ΔF	*B*	*SE*	β
Model 1	0.32	0.103	0.103	327.78	327.78***			
Constant						110.24	27.76	
Student age						13.96	1.87	0.09***
Socio-economic status						21.83	0.89	0.31***
Model 2	0.38	0.142	0.040	316.70	264.37***			
Constant						29.59	27.59	

Student age						13.04	1.83	0.09***
Socio-economic status						18.95	0.89	0.27***
Computer self-efficacy						11.80	0.73	0.20***
Model 3	0.44	0.192	0.050	227.11	118.09***			
Constant						-67.13	27.58	
Student age						14.14	1.78	0.10***
Socio-economic status						17.28	0.88	0.24***
Computer self-efficacy						9.27	0.72	0.16***
Confidence in science						8.40	0.84	0.17***
Like learning science						5.06	0.93	0.10***
Valuing science						-1.50	0.87	-0.03
Model 4	0.45	0.199	0.007	203.13	48.06***			
Constant						-38.87	27.76	
Student age						13.33	1.78	.09***
Socio-economic status						17.06	0.86	.24***
Computer self-efficacy						9.61	0.72	.17***
Confidence in science						9.05	0.85	.18***
Like learning science						7.09	0.97	.14***
Valuing science						-0.50	0.88	-.01
Instructional clarity						-5.52	0.80	-.10***

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Table 3 presents the hierarchical multiple regression analysis results for science achievement, examining the incremental contribution of different predictor variables across four models.

Table 3 reports that home resources and students' ages were entered in Model 1, explaining 10.3% of the variance in science achievement ($\Delta R^2=0.103$). When student age, socioeconomic status, and computer self-efficacy were entered in Model 2, the variance explained by the model was 14.2% ($\Delta R^2=0.140$). In Model 3, students' age, socioeconomic status, computer self-efficacy, confidence in science, and learning science were entered, and the total variance explained was 19.2% ($\Delta R^2=0.050$). In the final Model 4, after the entry of students' age, socioeconomic status, computer self-efficacy, confidence in science, like learning science, valuing science, and instructional clarity, the total variance explained by the model as a whole was 19.9% ($\Delta R^2=0.007$). $F(7, 5720) = 203.134$, $p < .001$.

In the final model, all the variables were statistically significant: students' age ($\beta=.089$, $p < .001$), home resources ($\beta=.240$, $p < .001$), computer self-efficacy ($\beta=.166$, $p < .001$), confidence in science ($\beta=.178$, $p < .001$), like learning science ($\beta=.140$, $p < .001$) and instructional clarity ($\beta=.104$, $p < .001$) except valuing science ($\beta= -.009$, $p = .566$).

Overall, the results suggest that socioeconomic status, computer self-efficacy, and confidence in science are the most robust predictors of science achievement across all models. While students' enjoyment of learning science and instructional clarity contribute significantly, the role of valuing science remains unclear. The incremental changes in statistical significance highlight how each newly added variable interacts with prior predictors, refining our understanding of what drives science achievement among students.

5. Discussion

This study examined the relationships between student age, socioeconomic status, computer self-efficacy, confidence in science, like learning science, valuing science, instructional clarity, and science achievement. The study finds that all independent variables are positively and significantly associated with science achievement. The first independent variables, student age and socioeconomic status, explained 10.3% of the change in science achievement. It can be concluded that socioeconomic factors play a significant role in science achievement among students in Dubai. The finding of this study is aligned with and supported by previous studies showing numerous ways socioeconomic circumstances may affect kids' capacity to learn science (Nguyen & Riegle-Crumb, 2021), establishing a link between socioeconomic status and science achievement, but keeping in mind that this an association rather than a causal relationship. According to research, children from higher socioeconomic backgrounds perform better in science than their counterparts from lower socioeconomic backgrounds (Brockhouse, 2019). Science achievement, which is proven by research to embed the acquired knowledge, skills, and attitudes, is significantly impacted by factors like income and financial resources, according to Burroughs et al. (2019). Students from wealthier backgrounds frequently have access to additional educational resources, such as support materials and access to cutting-edge technology; they might also participate in different clubs to strengthen their skills, which ultimately affect their well-being. These resources can help kids perform better on science tests by fostering a greater understanding and excitement.

When another independent variable, computer self-efficacy, was entered, Model 2 explained a 14.2% change in science achievement. It is important to note that computer self-efficacy is a significant factor contributing to science achievement, or at least can predict it, which previous studies have corroborated. Higher computer self-efficacy is frequently linked to improved productivity, greater openness to embracing new technologies, and more favorable attitudes about learning (Torres et al., 2022). The vast majority of learning resources are computer-based. For students, locating and choosing pertinent materials is vital to enhancing their learning (Hatlevik et al., 2018). Higher levels of computer self-efficacy may make students more willing to look for and take advantage of technological opportunities, such as searching for online learning resources, which favorably impacts students' engagement in science, for example, collecting data for their created hypothesis to conduct an investigation which is a higher order thinking skills learning technique (Abdullah & Mustafa, 2019).

In Model 3, confidence in science, like learning science and valuing science, was entered, and the results show that 19.2% accounted for the changes in science achievement. Finally, instructional clarity was entered into Model 4, and the model explained a 19.9% change in science achievement. Thus, the conception of learning science resulted in the most significant changes in science achievement compared to socioeconomic status and computer self-efficacy. The role of conception in learning science is also corroborated by previous research. According to Broer et al. (2019b), students interested in learning science who do not find it dull are likelier to be engaged in the classes and produce superior learning outcomes. Jufrida et al. (2019b) also confirmed that liking the science learning process and looking forward to the learning sessions positively engages students, leading to enhanced science achievement. The clarity of the instruction significantly impacts students' ability to learn science (Yagan, 2021). Higher instruction clarity has been demonstrated to improve student comprehension and academic performance (Chen & Lu, 2022; Teig & Nilsen, 2022). Students who are confident in their ability to learn and succeed in science courses are said to be confident in that subject. As a result of improved science learning abilities and positive concepts, confident students acquire superior results (Balfaqeeh et al., 2022). On the other hand, students who respect science and think it is helpful to engage in deeper learning and do better in science topics, making the value of science an insightful indicator of science learning (Awang et al., 2021). Students with a higher intrinsic value for science put more effort into their scientific studies and achieve more in the subject, according to Berger et al. (2020).

The study supports previous research on the way kids think about learning science, their socioeconomic status, and how confident they are using computers to be important aspects that can influence their science achievement. Students' perceptions of learning science are influenced by their environment, beliefs, attitudes, and strategies for learning scientific subjects (Liu et al., 2020; Jufrida et al., 2019a) and confirmed by this study conducted in Dubai. Similarly to this, students' thoughts and perspectives about their computer self-efficacy represent their assurance and confidence in their ability to use computers effectively to transfer what has been learned, leading to better scientific achievement (Wang & Zheng, 2020), as also found in students in Dubai.

To extend the localization of this study to an international relevance, it is essential to note that the findings from Dubai, a multinational city that could offer a higher exposure level of diverse perspectives, can contribute to a broader understanding of how students' socioeconomic status, computer self-efficacy, and conceptions of learning science predict science achievement in diverse educational contexts. Similar to these factors, science achievement has also been impacted in various global settings for eighth-grade students and other school grades in high-income and low-income countries. The association observed in this study can inform international educational policy and practices, particularly in regions aiming to improve science teaching and learning through remedial plans, lesson planning, curriculum design, empirical targeted interventions based on socioeconomic factors, and technology integration in pedagogical practices.

6. Conclusion

The current study concluded a significant association between student age, socioeconomic status, computer self-efficacy, conceptions of learning science (like learning science, instructional clarity, confidence in science, and valuing science), and science achievement is significant. The study found that all independent variables were positively linked with science achievement. Students' socioeconomic status positively impacted science achievement, conceptions of science learning (like learning science, clarity of the instructions, confidence in science, and valuing science), and computer self-efficacy.

7. Suggestion

It is recommended that policymakers aim to eradicate socioeconomic disparities among students. Policymakers should establish programs and policies that give equal opportunities and resources to vulnerable students. This is achieved by providing children experiencing socioeconomic learning barriers with additional support, resources, and individualization. A good learning environment that is efficient and favorable must be established to promote science learning principles that result in increased student involvement and learning. Teachers should make their lesson plans clearer in science instruction. Educate and equip teachers with resources that make scientific principles and steps understandable to the students. Teachers should give clear, concise descriptions, utilize visual means, and offer real-life examples so students can understand better.

Attempts should be made, and programs should be planned and implemented to build the confidence level of the students in learning science. The students should be provided with problem-solving and inquiry-based learning opportunities that build their confidence in learning science and critical thinking (Khurma et al., 2023). The students should be made familiar with the application of science. They should be introduced to career opportunities that they could be granted in the future due to learning science. Teachers should be familiar with the application of computer self-efficacy in learning science. The students should be provided with technological tools, and correct guidance and support should be given when using computers and other digital tools to perform science experiments. Compared with other countries, comparison studies should be held to observe the influence of socioeconomic status, computer self-efficacy, and conceptions in learning science in the UAE. In this study, Dubai's eighth-grade students were targeted alone. Further studies can be made concerning the rest of the Emirates.

The study emphasizes the salience of socioeconomic status in predicting science achievement. Reduced socioeconomic disparities in the student population should be a significant concern for policymakers and educators. This includes removing economic barriers, imparting learning resources to all the students, and setting up specialist support services for disadvantaged students. Further, the study identifies that computer self-efficacy is predictive of science achievement. Teachers should pay attention to developing computing skills among the students and making them self-efficacious in learning through technology. Computer self-efficacy among the students, which is a pointer towards their science achievement, can be increased by integrating technology-based learning resources and imparting proper training. The study emphasizes the perception among the students that learning science is worth their science achievement, which includes scientific concept knowing, instructional clarity, science confidence, and science enjoyability. Explicit instruction in teaching, developing a favorable attitude towards science, and developing deep conceptual awareness among the children should be areas of concern in teaching methods. Inquiry learning, practical classes, and applying scientific learning in practical contexts help implement this change. Policymakers and educators can implement relevant approaches and methods for improvement in science achievement among UAE students, which will lead to the development of a capable force in science in the future.

Declarations

Conflicts of Interest. The authors declare no conflict of interest.

References

Abdullah, Z. D., & Mustafa, K. I. (2019). The underlying factors of computer self-efficacy and the relationship with students' academic achievement. *International Journal of Research in Education and Science*, *5*(1), 346–354.

Aboderin, O. S., & Laleye, A. M. (2019). The relationship between online interaction and academic performance of distance E-learners in a Nigerian university. *American International Journal of Education and Linguistics Research, 2*(1), 25–33. https://doi.org/10.46545/aijelr.v2i1.72

Abu Khurma, O., Al Darayseh, A., & Alramamneh, Y. (2022). A framework for incorporating the “learning how to learn” approach in teaching STEM education. *Education Sciences*, *13*(1), 1. https://doi.org/10.3390/educsci13010001

Areepattamannil, S. (2024, December). Building a knowledge economy: higher education as a catalyst for the United Arab Emirates' visionary growth. In *Frontiers in Education* (Vol. 9, p. 1510421). Frontiers Media SA.

Awang, H., Hashim, F., Haji Salleh, A. L., & Tan, L. Y. (2021). The influence of mathematics score and student factors on science achievement using TIMSS data. *Eurasia Journal of Mathematics, Science and Technology Education, 17*(6), Article em1976. https://doi.org/10.29333/ejmste/10931

Balfaqeeh, A., Mansour, N., & Forawi, S. (2022). Factors influencing students’ achievements in the content and cognitive domains in TIMSS 4th grade science and mathematics in the United Arab Emirates. *Education Sciences, 12*(9), Article 618. https://doi.org/10.3390/educsci12090618

Berger, N., Mackenzie, E., & Holmes, K. (2020). Positive attitudes towards mathematics and science are mutually beneficial for student achievement: A latent profile analysis of TIMSS 2015. *The Australian Educational Researcher, 47*(3), 409–444. https://doi.org/10.1007/s13384-020-00379-8

Brockhouse, A. (2019). *Class Matters: School Affluence and Other Predictors of Attainment for Wealthy and Poor Students*. CUNY Academic Works. https://academicworks.cuny.edu/gc_etds/3417

Broer, M., Bai, Y., & Fonseca, F. (2019a). *A review of the literature on socioeconomic status and educational achievement*. Springer International Publishing. https://doi.org/10.1007/978-3-030-11991-1_2

Broer, M., Bai, Y., & Fonseca, F. (2019b). *Socioeconomic inequality and educational outcomes: An introduction*. Springer International Publishing. https://doi.org/10.1007/978-3-030-11991-1_1

Burroughs, N., Gardner, J., Lee, Y., Guo, S., Touitou, I., Jansen, K., & Schmidt, W. (2019). *Teacher effectiveness and educational equity*. Springer International Publishing. https://doi.org/10.1007/978-3-030-16151-4_7

Cai, S., Liu, E., Yang, Y., & Liang, J. (2018). Tablet-based AR technology: Impacts on students’ conceptions and approaches to learning mathematics according to their self-efficacy. *British Journal of Educational Technology, 50*(1), 248–263. https://doi.org/10.1111/bjet.12718

Chen, M., & Hastedt, D. (2022). The paradoxical relationship between students’ non-cognitive factors and mathematics and science achievement using TIMSS 2015 dataset. *Studies in Educational Evaluation, 73*, 101145. https://doi.org/10.1016/j.stueduc.2022.101145

Chen, X., & Lu, L. (2022). How do classroom management and instructional clarity relate to students' academic emotions in Hong Kong and England? A multi-group analysis based on the control-value theory. *Learning and Individual Differences, 98*, 102183. https://doi.org/10.1016/j.lindif.2022.102183

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2020). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284. https://doi.org/10.1080/15391523.2020.1781210

Evans, G. W., Li, D., & Whipple, S. S. (2020). Cumulative risk and child development. *Psychological Bulletin, 146*(4), 273-308. https://doi.org/10.1037/bul0000220

George, D., & Mallery, P. (2021). *IBM SPSS statistics 27 step by step*. Routledge. https://doi.org/10.4324/9781003205333

Han, F., & Ellis, R. A. (2019). Identifying consistent patterns of quality learning discussions in blended learning. *The Internet and Higher Education, 40*, 12–19. https://doi.org/10.1016/j.iheduc.2018.09.002

Harju-Luukkainen, H., Vettenranta, J., Wang, J., & Garvis, S. (2020). Family related variables effect on later educational outcome: A further geospatial analysis on TIMSS 2015 finland?. *Large-Scale Assessments in Education, 8*(1). https://doi.org/10.1186/s40536-020-00081-2

Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers & Education, 118*, 107–119. https://doi.org/10.1016/j.compedu.2017.11.011

Jufrida, J., Basuki, F. R., Kurniawan, W., Pangestu, M. D., & Fitaloka, O. (2019a). Scientific literacy and science learning achievement at junior high school. *International Journal of Evaluation and Research in Education (IJERE), 8*(4), 630. https://doi.org/10.11591/ijere.v8i4.20312

Jufrida, J., Kurniawan, W., Astalini, A., Darmaji, D., Kurniawan, D. A., & Maya, W. A. (2019b). Students' attitude and motivation in mathematical physics. *International Journal of Evaluation and Research in Education (IJERE), 8*(3), 401. https://doi.org/10.11591/ijere.v8i3.20253

Kabaila, P., Farchione, D., Alhelli, S., & Bragg, N. (2020). The effect of a Durbin–Watson pretest on confidence intervals in regression. *Statistica Neerlandica*, *75*(1), 4–23. https://doi.org/10.1111/stan.12222

KHDA - Resources on education in dubai. (2022). Khda.gov.ae. https://web.khda.gov.ae/en/Resources/Publications/International-Assessments/Dubai-TIMSS-2019

Khurma, O. A., Ali, N., & Hourani, R. B. (2023). The effect of the web-quest inquiry learning model in enhancing critical thinking and motivation for grade eight science students. In *Handbook of Research on Facilitating Collaborative Learning Through Digital Content and Learning Technologies* (pp. 238-260). IGI Global.

Kolil, V. K., Muthupalani, S., & Achuthan, K. (2020). Virtual experimental platforms in chemistry laboratory education and its impact on experimental self-efficacy. *International Journal of Educational Technology in Higher Education, 17*(1)https://doi.org/10.1186/s41239-020-00204-3

Liu, J., Peng, P., & Luo, L. (2020). The relation between family socioeconomic status and academic achievement in china: A meta-analysis. *Educational Psychology Review, 32*(1), 49–76. https://doi.org/10.1007/s10648-019-09494-0

Martin, M. O., & Mullis, I. V. S. (2019). TIMSS 2015: Illustrating advancements in large-scale international assessments. *Journal of Educational and Behavioral Statistics, 44*(6), 752–781. https://doi.org/10.3102/1076998619882030

Nguyen, U., & Riegle-Crumb, C. (2021). Who is a scientist? The relationship between counter-stereotypical beliefs about scientists and the STEM major intentions of Black and Latinx male and female students. *International Journal of STEM Education*, *8*(1). https://doi.org/10.1186/s40594-021-00288-x

Peciuliauskiene, P. (2022). School students' motivation for learning physics: How does instructional clarity in physics lessons engage? *Society.Integration.Education. Proceedings of the International Scientific Conference, 1*, 486–496. https://doi.org/10.17770/sie2022vol1.6815

OECD. (2021). *PISA 2018 Results (Volume I): What students know and can do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Reardon, S. F. (2016). School segregation and racial academic achievement gaps. *RSF: The Russell Sage Foundation Journal of the Social Sciences, 2*(5), 34–57. https://doi.org/10.7758/rsf.2016.2.5.03

Ryan, R. M., & Deci, E. L. (2020). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Publications.

Teig, N., & Nilsen, T. (2022). Profiles of instructional quality in primary and secondary education: Patterns, predictors, and relations to student achievement and motivation in science. *Studies in Educational Evaluation, 74*, 101170. https://doi.org/10.1016/j.stueduc.2022.101170

Torres, C., Correia, J., Compeau, D., & Carter, M. (2022). Computer self efficacy: A replication after thirty years. *AIS Transactions on Replication Research, 8*https://doi.org/10.17705/1atrr.00076

Schunk, D. H., & DiBenedetto, M. K. (2021). Motivation and social-emotional learning: Theory, research, and practice. *Educational Psychologist, 56*(1), 45-59. https://doi.org/10.1080/00461520.2021.1884907

Schunk, D. H., & Zimmerman, B. J. (Eds.). (2023). *Self-regulation of learning and performance: Issues and educational applications*. Taylor & Francis.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review. *Review of Educational Research, 75*(3), 417-453. https://doi.org/10.3102/00346543075003417

Velayutham, S., & Aldridge, J. M. (2012). Influence of psychosocial classroom environment on students' motivation and self-regulation in science learning: A structural equation modeling approach. *Research in Science Education, 43*(2), 507–527. https://doi.org/10.1007/s11165-011-9273-y

Wang, M., & Zheng, X. (2020). Using game-based learning to support learning science: A study with middle school students. *The Asia-Pacific Education Researcher, 30*(2), 167–176. https://doi.org/10.1007/s40299-020-00523-z

Wiberg, M. (2019). The relationship between TIMSS mathematics achievements, grades, and national test scores. *Education Inquiry, 10*(4), 328–343. https://doi.org/10.1080/20004508.2019.1579626

Yagan, S. A. (2021). The relationships between instructional clarity, classroom management and mathematics achievement: Mediator role of attitudes towards mathematics. In W. B. James, C. Cobanoglu, & M. Cavusoglu (Eds.), *Advances in global education and research* (Vol. 4, pp. 1–11). USF M3 Publishing. https://www.doi.org/10.5038/9781955833042

Yin, L., Bezirhan, U., Fishbein, B., & Foy, P. (2023). *Implementing the PIRLS 2021 achievement scaling methodology.* TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.tr2103.kb3067 http://dx.doi.org/10.6017/lse.tpisc.tr2103.kb3067

Zhang, F., & Bae, C. L. (2020). Motivational factors that influence student science achievement: A systematic literature review of TIMSS studies. *International Journal of Science Education, 42*(17), 2921–2944. https://doi.org/10.1080/09500693.2020.1843083

About the Contributor(s)

Dr. Nagla Ali, Emirates College for Advanced Education, Abu Dubai, UAE
Email: nali@ecae.ac.ae

Dr. Dr. Othman Abu Khurma, Emirates College for Advanced Education, Abu Dubai, UAE
Email: Othman.abukhurma@ecae.ac.ae

Dr. Khadeegha Alzouebi, Hamdan Bin Mohammed Smart University, School of e-Education, Dubai, United Arab Emirates, P.O.Box 71400
Email: k.alzouebi@hbmsu.ac.ae

Adeeb Jarrah, Emirates College for Advanced Education, Abu Dubai, UAE
Email: adeeb.jarrah@ecae.ac.ae

Prof. Myint Swe Khine, Curtin University, Bentley, WA, AUSTRALIA
Email: m.khine@curtin.edu.au

Fayrouz Albahti, Imam Mohammad Ibn Saud Islamic University, Riyadh, SAUDI ARABIA
Email: drfayrouzalbahti@yahoo.com

Qasim AlShannag, Emirates College for Advanced Education, Abu Dubai, UAE
Email: qasim.alshannag@ecae.ac.ae