



# STEAM Education in Saudi Arabia: Early Childhood Teachers' Perceptions

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## Abstract

The purpose of this study is to ascertain the perspectives of Saudi teachers working in early childhood education settings on STEAM education. 200 kindergarten teachers were included in the study's sample. Ten open-ended questions assessed teachers' attitudes toward incorporating STEAM practices into their classrooms, while two closed-ended questions assessed teachers' knowledge and familiarity with STEAM education terminology. The findings indicate that while the general public views STEAM education positively, its implementation is viewed with caution. The study's findings indicate that while teachers are familiar with the term "STEAM," they lack a firm grasp on implementation strategies and fundamental skills. Additionally, the study's findings indicate that most Saudi teachers felt they required additional training and professional development in the STEAM implementation process. A chi-square test revealed correlations between teachers' beliefs and knowledge about STEAM education that were statistically significant. Finally, we discussed the results and made some recommendations for the future.

**Disciplinary:** Education (Early Childhood Education, Information Technology in Education)

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## 1 Introduction

Students in grades K–12 are typically taught using STEAM education, which is a science-based, multidisciplinary approach to education. STEAM stands for science, technology, engineering, mathematics, and the arts. Children's natural curiosity and excitement for exploration and discovery are fostered by integrating these five critical disciplines into STEAM education.

Simultaneously, students taught in this manner must demonstrate the capacity for critical and creative thinking in order to lay the groundwork for future academic success. To prepare today's children for a successful life and future, educators must adopt a new approach that integrates multiple content areas. Children in the twenty-first century require increased critical thinking training to overcome the obstacles they will face. Despite increasing global competitiveness, education is under increasing pressure to prepare students to address recent global issues. Concerns about a shortage of well-prepared students entering STEM-related careers in the United States prompted the establishment of STEAM [1]. SMET was the initial acronym; this was a National Science Foundation initiative. Additionally, there were concerns about the association between SMET and the term smut, which proved difficult to overcome. In 2001, the term STEM introduced a new approach to teaching students how to be creative problem solvers in the millennium [2,3]. STEAM has been renamed to include the arts. In addition to the scientific content of STEM, the inclusion of creative and innovative spirits through the arts has created new opportunities for students' imaginations to develop. By integrating traditional subjects such as math and science with more creative ones such as art, students develop a stronger grasp of both creative and logical-mathematical thinking. According to [4], There are numerous advantages to incorporating the arts into STEM education, such as creativity stimulation, brain stimulation, long-term memory improvement, novelty, and social development. Art is a natural outlet for young children to exercise their imaginations and develop their problem-solving abilities in an engaging, hands-on setting [5].

## 2 Literature Review

Saudi Arabia's efforts to modernize its educational system have been hampered by globalization. Saudi Arabia has made significant efforts over the last two decades to reform its educational system. King Abdullah bin Abdul-Aziz's Public Education Development Project (KAAPEDP) was launched in 2007 in response to the country's extensive economic and social development. [6]. Tatweer, an Arabic term for development, was intended to supplant traditional Saudi education with a more innovative and technologically advanced model. This project placed a premium on technology-enhanced learning environments and the qualifications of classroom instructors [7]. The project made no specific reference to STEAM curricula. In 2015, with the aid of the National Association for the Education of Young Children (NAEYC), the Saudi Ministry of Education produced the Saudi Early Learning Standards (SELS) [8] addressed preschool-aged children (ages 3–6) with the goal of providing educators, parents, and other caregivers with the most up-to-date information on best practices for that age group. Seven standards for children's learning at all ages were outlined in the document. Teaching measurement and geometry concepts place a premium on spatial awareness and form dimension. The following subthemes within cognition and general knowledge have a clear connection to STEAM content (See Table 1).

**Table 1: STEAM content and its connection to cognition and general knowledge.**

subtheme	General and cognition knowledge
Science	In the Science strand, students will study scientific inquiry, physics, biology, and ecology.
Mathematics	The Mathematical Sciences strand of the curriculum covers all aspects of mathematics, including numbers, quantity, measurements, and geometry. Teachers can use the following examples with their students: Describe and create simple patterns by exploring the estimated size of the volume to understand the numbers represent quantity.
Creative Arts	The Creative Arts program fosters children's bodies, minds, and actions in a nurturing environment. Children express themselves creatively and expressively through art, drama, chants, and expressive movement. One of the teacher-recommended techniques is the artistic expression of one's feelings and knowledge.
Technology	This strand focuses on acquainting students with technology and developing their proficiency with interactive and multimedia technology. This category includes activities such as "play with mechanical toys" and "learn through mechanical toy play [8].

There are several age-appropriate behaviors included in the SELS statement's cognition and general knowledge requirements. Additionally, these activities assist kids in acquiring a strong foundation in science, technology, engineering, the arts, and mathematics by fostering critical thinking and problem-solving skills (STEM). However, these conceptions express the primary domains of scientific thought as developing activities. It doesn't offer any guidance to educators on how to categorize content integration as a STEAM investigation. In-service teacher training began in early 2018 as a result of the SELS statement's 2015 release. Promoting STEAM concepts in a setting rich in social and digital culture was the focus of an encouraging campaign. An educational truck equipped with advanced 4IR equipment and scientific materials has been launched by the Ministry of Communications and Information Technology and the Ministry of Environment [8] to promote the Future Trucks program. Parents and guardians of children, particularly those with an interest in digital fabrication, will get something from the vehicles, as well. We can see this trend in the 4th Industrial Revolution through the Internet, robotics, and artificial intelligence [9].

### 3 Literature Review

The goal of this study is to shed light on Saudi teachers' perspectives on STEAM's role in early childhood education in light of substantial changes to the Saudi educational system's policy and philosophy in recent years. The attitudes of early childhood educators in Saudi Arabia towards STEAM education and its applications have not been properly investigated. There is a dearth of research on STEAM in early childhood education in Saudi Arabia, despite the fact that multiple studies on Saudi teachers and their perceptions of critical STEAM content have been undertaken [10,11,12,13,14,15]. As a result, the goal of this study is to acquire a better knowledge of the viewpoints of Saudi teachers on STEAM education through the examination of a collection of teacher statements. The study focuses on teachers' STEAM education expertise and professional growth. Through this investigation, we sought to address the following research concerns:

- Q1.** What are the thoughts of early childhood educators in Saudi Arabia on STEAM education?
- Q2.** There is a link between Saudi instructors' attitudes towards STEAM education and their understanding of the context.

## 4 Method

A quantitative survey was used to elicit the perspectives of Saudi instructors on STEAM instruction in early childhood settings. Prior to the start of this inquiry, the author's university's Committee on Research Ethics supplied an IRB permission form. Each instance included adherence to ethical standards. Before accessing the survey, each participant provided electronic informed consent, implying that participation in the study was entirely voluntary. Participants were told that they could leave the study at any time with no consequences.

## 5 Instrument

To address the study questions, an instrument was developed based on a review of empirical studies [15,16] that examined the setting of STEAM education in early childhood education. The researcher surveyed teachers in Saudi Arabia to ascertain their perspectives on STEAM education in early childhood settings. Teachers' attitudes toward STEAM education and its implementation in the classroom, as well as their knowledge of STEAM and professional development in the field of STEAM education in early childhood settings, were assessed via a survey consisting of ten items and two closed-ended questions (yes/no). How did you get in touch with us? Early childhood STEAM education may be a new concept to you. Has STEAM education been used in your classroom before? Do you have experience instructing students in the STEM fields? No, I've never taken part in a STEM-related conference or workshop.

Experts analyzed the survey's content and context to ensure that each question was scientifically accurate and pertinent. An assistant professor and an associate professor will conduct the final evaluation for this course. Their suggestions and suggestions for improvement were quite helpful in the ultimate design of the instrument they helped to create. The instruments were also subjected to peer assessment by Arabic and English-fluent professors. A pilot group tested the survey before it was used in the main study. According to Cronbach's alpha coefficient, the survey was found to be reliable on all 10 scales. Pearson's correlation coefficient was used to evaluate the internal validity of the survey statements (the correlation between each item and the overall scale to which it belongs). To apply these items to a sample, the correlation coefficients have a statistical significance level of 0.01 or 0.05.

## 6 Gathering and Examining Information

Participants in the research were Saudi kindergarten instructors with children ranging in age from three to six years. Social media, Telegram, and e-mail were used to distribute the survey. The participants were asked to score their level of agreement with a series of practices in order to better understand how STEAM education is applied in early childhood education. Teachers were asked to score how closely their opinions corresponded with each of the survey's assertions on a 5-point Likert scale (where 1 means "not like me," 2 means "not much like me," 3 means "somewhat like me," 4 means "mostly like me," and 5 means "really like me"). Analysis of the data was carried out using statistical software for social science (SPSS). To answer the study objectives, descriptive statistics and chi-square tests were utilized. The average and standard deviation of teachers' views

on STEAM education, as well as the percentages and frequencies, were determined. To answer the study's research questions, chi-square tests were used to evaluate teachers' STEAM education professional growth and beliefs.

## 7 Characteristics of Samples

For this study, 200 early childhood teachers in Saudi Arabia were surveyed. All participants placed a premium on early childhood education. Diplomas and master's degrees were the most frequently earned degrees (10% and 10%, respectively), whereas bachelor's degrees were 80 percent. Teachers in public kindergartens made up 43% of the sample, while educators in private kindergartens (35%), and international kindergartens (22%) made up the remainder. Among them, 60% had less than five years of experience, while 20% had at least ten years of teaching experience (See Table 2).

**Table 2:** Study population statistics.

Characteristic	n	%
Degree (n = 200)		
Diploma	20	10
Bachelor's	160	80
Master's	20	10
Years of experience (n = 200)		
Less than 5 years	120	60
More than 5 years	40	20
10 years or more	40	20
Type of school (n = 200)		
Public	86	43
Private	70	35
International	44	22

## 8 Results

### 8.1 Findings on Teacher's Perspective

Teachers are often baffled when it comes to STEAM topics in early childhood education. 86 percent of teachers polled said that STEAM education is essential for the development of children's cognitive abilities (91%).

**Table 3:** A teacher's perspective on STEAM education.

	Statements	M	SD
1	STEAM education is vital, in my opinion, for the future generation.	1.66	0.66
2	One of my favorite aspects of my job is teaching STEAM subjects.	2.6	0.84
3	As a teacher, I am comfortable incorporating STEAM concepts and activities into my classroom lessons.	2.63	0.90
4	STEAM activities are a regular part of my classroom activities.	3.29	0.91
5	I am well-versed in integrating a diverse range of STEAM-related topics and activities into the school's core subject areas.	3.21	0.94
6	I am familiar with incorporating STEAM into a school curriculum and can implement the most basic strategies and support resources.	3.21	0.91
7	My classroom lacks the necessary resources to teach and incorporate STEAM successfully.	2.67	0.89
8	As a teacher, I am constrained in my capacity to properly incorporate STEAM subjects into a curriculum.	1.85	0.64
9	Preschoolers' cognitive development, in my opinion, necessitates the inclusion of a STEAM curriculum.	1.63	0.65
10	I believe that teaching students about concepts and activities related to math, science, and engineering is appropriate for their age and stage of development.	1.64	0.66

Experts also agreed that concepts and activities in physics, mathematics, and engineering were appropriate for students of all ages and abilities (88%). More than half of the instructors who put their beliefs into action reported that they liked teaching STEAM courses and were confident in their ability to create and conduct STEAM activities (47%). Only 20% of instructors polled thought they were doing a good job of incorporating STEAM activities into their courses (See Table 3).

## 8.2 Findings on Instructors' Views and Understanding of STEAM

Instructors' views and understanding of STEAM were also explored in this study, especially if teachers had been exposed to STEAM from an early age. Next, we did a chi-square test on the relevant frequencies and percentages to see whether there was a correlation. STEAM was mentioned by 95 percent of the 200 instructors polled, compared to 5 percent who were unaware. According to the poll results, there were only 20% that did not employ STEAM principles in their courses. Chi-square tests were used to examine correlations. According to this data, teachers' opinions regarding STEAM education are strongly linked to their knowledge of STEAM principles. Findings showed that teachers' opinions on STEAM education were linked to their knowledge of STEAM in early education ( $p < 0.001$ ). The usage of STEAM education in the classroom was likewise connected with instructors' opinions towards it ( $p < 0.001$ ), as did its use in the classroom (see Table 4).

**Table 4:** Teachers' STEAM knowledge and beliefs measurement using the chi-square test.

Factor (teachers' knowledge)	Teachers' beliefs about STEAM education			
	Yes	No	Chi square	p-value
It's common knowledge that STEAM is used in early education.	190	10	100.221	0.000*
Teach students about STEM fields of study and technology in the classroom.	160	40	130.311	0.000*

## 9 Discussion

According to the findings of this study, there are a number of ways in which Saudi instructors feel that STEAM education might improve kindergarten education. Young children's cognitive development and capacity to learn in a manner suited to their age group have been found to benefit from STEAM education. Teacher attitudes towards incorporating STEAM subjects into the classroom and planning and executing lessons that do so at an acceptable pace were modest among Saudi Arabian educators. In addition, instructors were found to be lacking in their understanding of STEAM instruction. About a quarter of those polled said they knew how to include STEAM activities into their curriculum and the most basic methods for incorporating STEAM principles. The phrase "STEAM" was familiar to instructors, but many were unfamiliar with how to execute it and the tactics and abilities needed to do so. The majority of instructors in this research thought that they needed further training and professional development to properly include STEAM subjects into their curriculum. Here, the study's findings will be compared to earlier studies on the topic. Researchers found a link between instructors' self-perceived teaching expertise, their emphasis on the STEAM approach, and their readiness to use STEAM-based teaching methods in their classrooms. When asked whether or not they believed that STEAM

principles should be applied in their classrooms, the teachers who participated in this survey said they did not have the basic knowledge and abilities to do so. [17] asserted that teachers' understanding of STEAM is restricted due to a lack of familiarity with the multidisciplinary nature of STEAM education. To assist young children's cognitive development through STEAM education, teachers must be able to combine their knowledge of two or more STEAM courses. Teacher expertise in all STEAM subjects is not anticipated, according to research [18]. A teacher must always be professionally prepared to exhibit the requisite degree of competence to recognize and rectify gaps within their material knowledge, establish relevant connections with students' lives, and inspire them to think differently. Teaching strategies that translate STEAM components into meaningful experiences should be developed through the establishment of "thought habits" [19]. Education and training in STEAM-related knowledge and practices are required for Saudi Arabian teachers, especially in light of new teaching methodologies that call into question the mastery of pedagogical or cognitive components of teachers' activities. Numerous studies have highlighted the significance of STEAM teacher professional development in ensuring the program's success. As stated by [20], there is a clear need for more training and assistance in order to properly apply STEAM teachings. Teachers who attended a professional development conference were found to be more proficient and self-sufficient in their use of STEAM educational activities. Furthermore, instructors' self-efficacy and confidence may be bolstered by professional development workshops, which have been shown in [5]. Several studies have shown that the STEAM technique is advantageous to children's learning and that teachers feel more confident when they are equipped to teach STEAM concepts successfully. According to [15], teachers who have a greater sense of self-efficacy are more confident in their STEM teaching approaches. Teachers' capacity to integrate STEAM principles into their classrooms has been demonstrated to increase with well-designed professional development programs, according to Bush et al. The PrimeD framework [22] is one of these attempts.

There must be an emphasis on the theoretical foundations and visual models of STEM integration via cross-ideas, as well as the practical integration abilities essential to teach these concepts [23]. To teach STEAM topics effectively, teachers must be able to integrate various subject areas holistically and cognitively rather than focus on a single one. According to [23], STEAM courses should be taught utilizing a range of disciplines, but they should also allow for natural crossovers between them. Interdisciplinarity, multidisciplinary, and/or transdisciplinarity are all viable approaches to teaching STEAM ideas. As the name implies, "transdisciplinarity" is defined as the act of bringing together different domains and the space between them in order to produce new concepts. Using this method, pupils are able to establish connections between seemingly unrelated bits of information. Knowledge and abilities from different fields are brought together in an interdisciplinary approach. In this dimension, a learner is encouraged to produce fresh data. Multidisciplinary knowledge and skills, on the other hand, are the result of a wide range of disciplines, such as science and mathematics. For a STEAM deployment to be successful and strong,

good STEAM integration and utilization are essential. As hard as it may be for a teacher to fully incorporate STEAM into early childhood education, it is analogous to connecting jigsaw pieces to aid pupils in making sense of their surroundings. STEAM instructor training must involve the deliberate cultivation of openness to novel learning and teaching approaches that emphasize the integration of context and material. A teacher's comfort level with [23] is enhanced by his or her capacity to handle "uncharted territory," which includes the willingness to experiment, learn from mistakes, and keep trying new ideas. Teachers must be aware of their kids' developmental requirements and the most effective approaches to assist their learning while also teaching STEAM to elementary school children. Only a teacher who is well-versed in developmentally appropriate STEAM methods can put them into action effectively. For children in early infancy, STEAM education must be blended into their age and developmental stage to increase cognitive capability without abandoning play, exploration, and expressive art. Teachers in Saudi Arabia are largely in favor of teaching their kids about science, technology, engineering, and math (STEM). A lack of familiarity with STEAM and the procedures needed to execute it is holding them back, though.

Due to the study's limitations, teachers' replies to survey questions were not quantitatively assessed. It is suggested that more qualitative studies be conducted to get a deeper understanding of why educators react the way they do. It is possible to learn more about teachers' understanding of STEAM education by conducting interviews that are rich and detailed in nature.

## 10 Conclusion

Preliminary findings from this study show that Saudi Arabian early childhood instructors have a positive attitude toward STEAM education. We need to reconsider early childhood teachers' competencies given the wide range of teachers' views on how STEAM activities might be implemented in early childhood classrooms. Saudi Arabia's early childhood education initiatives and STEAM teacher training are currently under scrutiny. It also discusses the numerous options for continuing education that are open to teachers in today's workplace. STEAM was not a big priority in education for many of the instructors in this research when they were getting their bachelor's degrees. STEAM is a relatively new word in Saudi early childhood education, but educators are beginning to embrace it as an instructional tool. Saudi Arabian educators say STEAM principles are becoming increasingly important to them as they reevaluate the country's approach to early childhood education. STEAM-related curriculum areas require a critical evaluation of present teaching approaches. Assessing teachers' skill sets and filling knowledge gaps necessitates the use of suitable expertise and ongoing professional development. It is hoped that the conclusions of this study will encourage decision-makers and professionals in Saudi Arabia to join the STEAM movement. Consequently, educators must have the tools to keep up to date on STEAM education innovations and adapt to these new methods. Focusing on early childhood teacher development and support programs is essential to integrating STEAM instruction into the classroom. A digital platform for STEAM education might aid instructors in teaching youngsters as young as eight years old developmentally appropriate STEAM tasks. A digital platform is an

absolute necessity for Saudi Arabian instructors who want to share their opinions, experiences, and lessons learned from implementing STEAM pedagogy.

## 11 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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