EUROPEAN JOURNAL OF STEM EDUCATION

European Journal of STEM Education, 2025, 10(1), 30
ISSN: 2468-4368

lectito

The integrative learning approach in early childhood: A proposed framework based on STEM – a field study

Abdelrahim Fathy Ismail [1]*, Samia Mokhtar Shahpo [2]

[1] *King Faisal University, Al Ahsa,* SAUDI ARABIA
[2] *Imam Abdulrahman Bin Faisal University, Jubail,* SAUDI ARABIA

*Corresponding Author: afismail@kfu.edu.sa

Citation: Ismail, A. F., & Shahpo, S. M. (2025). The integrative learning approach in early childhood: A proposed framework based on STEM – a field study. *European Journal of STEM Education*, 10(1), 30. https://doi.org/10.20897/ejsteme/17477

Published: December 2, 2025

ABSTRACT

Integrative learning in early childhood is more than a teaching strategy; it is a philosophy that reflects how young children naturally view the world as a whole. Early childhood offers fertile ground for merging concepts of science, mathematics, and other domains through play, exploration, and discovery. Within this context, the present study explores the potential of the integrative learning approach in kindergarten from the perspective of STEM (science, technology, engineering, and mathematics). The study aimed to examine the requirements for activating integrative learning practices in early childhood education and the challenges that hinder their implementation, with the purpose of proposing a framework that responds to teachers' realities. A descriptive-analytical design was employed, using two structured questionnaires: the first explored challenges related to teachers, curricula, and classroom environments, while the second focused on requirements such as professional development, curriculum support, and classroom resources. Data were collected electronically from 270 kindergarten teachers across five Saudi cities and analyzed using descriptive statistics. Findings highlighted a complex landscape: while teachers recognized the promise of integrative STEM learning in fostering creativity, curiosity, and holistic development, they also pointed to gaps in training, rigid curricula, and limited resources. At the same time, they emphasized the need for professional development, flexible curricula, and supportive environments. Based on these insights, the study proposed a framework grounded in STEM principles that includes five interconnected elements: teacher preparation, curriculum design, classroom resources, integration philosophy, and monitoring and sustainability. The study recommends improving teacher preparation through ongoing professional development, promoting flexible curricula that support integrated STEM learning, and ensuring the availability of essential classroom resources. It also emphasizes continued collaboration among educators, curriculum developers, and policymakers to bring the proposed framework to life in creative and sustainable ways.

Keywords: Integrative learning approach, STEM, early Childhood, integrative learning environment, knowledge integration.

INTRODUCTION AND BACKGROUND

Integrative learning in early childhood is more than a teaching method; it is a philosophy that views the child as a whole. This approach removes traditional barriers between subject areas, allowing children to acquire foundational knowledge and concepts under the guidance of skilled teachers (Al-Sharabini & Al-Tanawi, 2011; Aberz, 2022). In early childhood education, integrative learning is often seen as inseparable from child development, since children naturally perceive the world in holistic ways rather than as fragmented subjects (Krogh

& Morehouse, 2020; Aufseeser, 2019; Gencer & Bartan, 2024; Chavez-Luque & Smith Q, 2025). As Nurfahma et al. (2024) emphasized, an integrative learning approach is both therapeutic and educational, supporting the child's health, nutrition, care, and overall development while creating an environment that encourages decision-making, self-expression, and natural curiosity.

Current research on child learning and development suggests that preschool children should not learn in isolated domains as they might later in school. Fragmented subject teaching at this age can lead to compartmentalized skills rather than integrated development (Kadijević et al., 2019). Moreover, such an approach limits learners' ability to transfer knowledge and engage fully in learning processes (Almarcha et al., 2023). In contrast, integrative learning fosters collaboration, empathy, and emotional intelligence by encouraging children to share ideas, listen to peers, and build on one another's strengths. Activities such as storytelling and group discussions further reinforce these social and emotional skills (Krogh & Morehouse, 2020).

Young children are naturally curious about the world around them, and integrative learning taps into this by offering opportunities for inquiry and exploration. Since real-world knowledge is not divided into subjects like mathematics or science, integrative learning reflects life's holistic nature and prepares children for meaningful engagement (AlAli & Al-Barakat, 2024; Zaenab, 2022; Suri & Chandra, 2021; Olalowo, 2020). However, the practical implementation of this approach faces challenges, including limited teacher preparation, children's communication difficulties, and inadequate infrastructure. Apriyansyah et al. (2024) found similar barriers in Indonesia, where despite the effectiveness of integrative learning, its implementation was hampered by insufficient funding and trained personnel, leading to recommendations for stronger collaboration between governments, communities, and parents.

To succeed, teachers must understand the principles of integrative and holistic learning models, such as centering the child, adapting to their needs, promoting learning through play, fostering creativity, and developing life skills in supportive environments (Pattiruhu, 2023). The benefits of such an approach include flexible thinking, higher levels of engagement, stronger connections across domains, and more authentic learning experiences (Krogh & Morehouse, 2020). Evidence from studies such as Jaber and Habib (2019), and Ramadan et al. (2023) confirm the positive impact of integrative learning on children's emotional, social, and cognitive development.

Within this broader context, STEM (science, technology, engineering, and mathematics) has emerged as a transformative approach in early education. Integrating STEM from the earliest years can spark children's interest, feed their curiosity, and equip them with foundational skills for lifelong learning (Ampartzaki & Kalogiannakis, 2023; Almarcha et al., 2023). Globally, STEM is considered a strategic response to educational reform, preparing students with adaptive skills for future challenges (Larkin & Lowrie, 2022). Successful implementation, however, requires well-prepared teachers and ongoing professional development to design inquiry-based, hands-on learning (Capraro et al., 2013). Evidence spans every stage from preschool to university, with early exposure shaping later competencies (Tomić, 2019; Karademir & Yıldırım, 2021; He et al., 2021). Complementing this, MacDonald et al. (2020) found that the "Little Scientists" program strengthened teachers' awareness of children's growing capabilities (e.g., creative thinking, problem solving, self-directed inquiry), increased children's motivation and confidence during STEM activities, and boosted teachers' self-efficacy-encouraging them to see themselves as co-learners and reflective practitioners in inquiry-rich, play-based settings. Local evidence such as Al-Harbi & Zaqzouq (2024) further demonstrates the effectiveness of STEAM-based integrative activities in enhancing creativity and problem-solving among kindergarten children. As shown in the study by Ribeirinha et al. (2024), STEM activities enhance students' interest and aspirations toward scientific careers, with gender, personal goals, and positive perceptions of STEM careers playing a significant role.

Previous studies reinforce this perspective. A study by Mohamed (2019) explored how enrichment activities based on STEM enhance scientific imagination and enjoyment in kindergarten children. El-Saadany et al. (2020) examined STEM activities for pre-kindergarten children, showing notable gains in life science concepts. El-Sayed et al. (2022) demonstrated how STEM fosters independence and self-learning, while Al-Shahri (2023) highlighted the Australian model, emphasizing supportive policies and teacher training. Almutairi (2023) provided evidence of STEM's role in strengthening critical thinking, problem-solving, and collaboration among older students in Saudi Arabia. Collectively, these studies reveal the promise of integrative STEM learning, while also pointing to challenges in teacher preparation, curricula, and infrastructure. As demonstrated by Rhodes et al. (2024), integrated language–science–technology instruction in elementary education positively affects all student-learning outcomes, with higher integration levels, shorter interventions, and teacher professional development yielding stronger effects. Collectively, these findings underscore the potential of an integrative STEM approach in early childhood education, while also revealing the need for a structured framework that can guide teachers in embedding such practices effectively within Saudi kindergartens.

Despite global recognition of the value of integrative STEM learning in early childhood, there is still limited application and empirical evidence in Arab educational contexts particularly in Saudi kindergartens. This gap

underscores the need for a framework that responds to local challenges and supports teachers in activating integrative STEM practices in early childhood education. The current study does not only aim to propose a framework in theory, but also to take into account the challenges and requirements identified by kindergarten teachers. By considering the obstacles that limit the application of integrative learning and the supports needed for effective practice, the study seeks to respond to classroom realities and provide a pathway toward improvement. The proposed framework based on STEM principles is thus envisioned as a practical guide that reflects teachers' voices and offers a structured way to make integrative learning a meaningful and sustainable practice in Saudi kindergartens.

STEM naturally aligns with integrative learning in early childhood because young children experience the world as one connected whole. They do not separate science from play or mathematics from exploration. Through STEM activities, children can investigate, build, question, and solve simple problems in ways that feel natural to their curiosity. In this sense, STEM supports the idea of learning through meaningful, hands-on experiences that help children connect ideas across different domains.

Integrative learning, in turn, provides the broader environment that allows STEM to flourish. It offers a flexible, child-centered philosophy where different subjects blend together during play, stories, and everyday classroom activities. When the learning environment encourages connections rather than separation, STEM becomes easier to embed in classroom routines. In this way, STEM strengthens integrative learning, and integrative learning gives STEM a practical and natural place within early childhood education.

Statement of the Problem

Early childhood is a critical stage in shaping children's curiosity, creativity, and foundational thinking skills. Yet in many Arab educational contexts, learning in kindergarten remains fragmented, with subjects and activities often taught in isolation rather than through an integrative approach (Mohamed, 2019). Early childhood education in many Arab contexts often suffers from a fragmented structure, where learning activities are taught separately and in isolation from one another. Instead of experiencing an integrated learning journey, children are frequently exposed to subject-specific activities that do not connect meaningfully with each other (El-Sayed et al., 2022; Şahin Kıralp & Ummanel, 2023). This fragmentation limits opportunities for holistic growth and the development of higher-order thinking skills. This separation limits children's opportunities to connect ideas, solve problems, and develop the kind of higher order thinking skills they will need in later learning and in life. At the same time, global experiences show that integrative approaches such as STEM can provide rich opportunities for young learners to explore, experiment, and build essential skills through hands-on, meaningful activities. Despite this promise, the reality in early childhood classrooms across the region reveals challenges related to teacher preparation, curriculum design, and classroom environments, leaving a clear gap between potential and practice (El-Saadany et al., 2020).

At the same time, there are well-documented barriers that hinder the adoption of integrative approaches in early childhood education in general, and STEM in particular. These barriers are evident at several levels:

- Teacher-related challenges such as limited training, difficulty in designing STEM-based activities, and constraints of time and workload.
- Curriculum-related challenges where learning objectives and activities are often compartmentalized and lack opportunities for cross-disciplinary integration.
- Classroom environment constraints including insufficient resources, limited budgets, and a lack of supportive infrastructure to implement STEM-based practices.

STEM, as an integrative approach, is widely recognized for its potential to connect science, technology, engineering, and mathematics through child-centered, hands-on, and problem-based learning experiences. Its philosophy emphasizes discovery, logical and scientific thinking, and decision-making through real-life problem solving. However, the gap between this promising potential and its actual implementation in early childhood classrooms remains substantial.

As highlighted in previous studies, such as Al-Harbi (2024), kindergarten teachers in Saudi Arabia face numerous challenges in applying the STEM approach. Among the most critical were the extensive time required to design and implement STEM activities, difficulties in preparing and executing these activities effectively, and the lack of sufficient funding to support classroom implementation. Almutairi (2023) confirmed that there is a clear gap in Arab educational contexts, where the effectiveness of STEM is well established at higher stages but its application in early childhood remains very limited. In contrast, the study by Walshe et al. (2025) revealed limited implementation of the STEAM approach in early childhood education despite improvements in educators' knowledge after training. The study proposed a new conceptual framework, "STEAM from the Start," aimed at strengthening educators' skills and confidence and supporting the integration of STEAM into their pedagogical practice. This gap underscores the need for a proposed framework to activate integrative STEM practices in kindergarten.

Given these realities, there is a pressing need to design a proposed framework based on STEM and grounded in the integrative learning approach to support kindergarten teachers in overcoming these barriers. Such a framework could provide clear foundations for activating integrative learning practices that are meaningful, feasible, and responsive to the developmental needs of young children.

Research Objectives

In light of the identified gap between the proven effectiveness of STEM in developing higher order thinking skills and the challenges facing its application in early childhood, this study seeks to achieve the following objectives:

1. To explore the current challenges that hinder the implementation of integrative learning approaches in kindergarten classrooms from the perspective of teachers.
2. To identify the key requirements for activating STEM-based practices in early childhood education.
3. To design a proposed framework for integrative learning in early childhood based on STEM principles.

Research Questions

In line with the objectives, the study seeks to answer the following questions:

1. What are the current challenges that hinder the implementation of integrative learning approaches in kindergarten classrooms from the perspective of teachers?
2. What are the key requirements for activating STEM-based practices in early childhood education?
3. What are the key elements of the Proposed Framework for integrative learning in early childhood based on STEM principles?

METHODOLOGY

Research Design

The study employs a descriptive survey method. The study adopts a descriptive survey design with an analytical orientation. This approach was chosen because it allows the researcher not only to collect data on current realities but also to interpret and analyze them in order to draw meaningful conclusions. In this sense, the study is both descriptive and analytical: it describes the challenges and requirements identified by kindergarten teachers, and at the same time it analyzes these findings to shape practical directions for improvement.

To operationalize this design, two questionnaires will be employed. The first targets kindergarten teachers' perspectives on the challenges that hinder the implementation of integrative learning approaches in their classrooms. The second focuses on identifying the requirements necessary to activate STEM-based practices in early childhood education.

The combination of these two instruments will generate a comprehensive picture: quantitative data will highlight the prevalence of certain issues, while the analytical interpretation of these results will make it possible to build the Proposed Framework for integrative learning in early childhood based on STEM principles.

The following flowchart illustrates the research design and process, which is structured around three main axes:

- Identifying the challenges that hinder the implementation of integrative learning approaches in kindergarten classrooms.
- Identifying the requirements necessary for activating STEM-based practices in early childhood education.
- Developing the Proposed Framework for integrative learning in early childhood based on STEM principles.

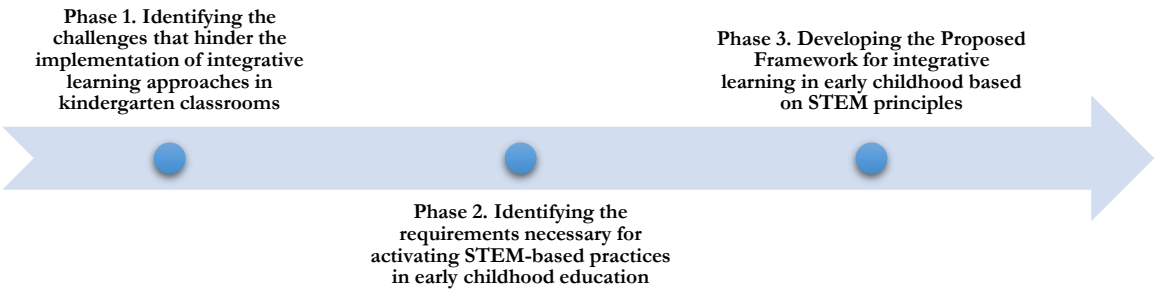

Figure 1. The Main Stages of the Research Design

Participants and Sampling

The participants in this study consisted of 270 kindergarten teachers drawn from both public and private preschools across five cities in Saudi Arabia: Riyadh, Al-Hofuf, Al-Mubarraz, Dammam, and Khobar. To ensure diversity and depth, a snowball sampling strategy was adopted. The process began by contacting an initial group of ten teachers from each city, who then facilitated access to wider networks of colleagues. This approach was particularly useful in reaching teachers across different types of kindergartens and varying school contexts, ultimately ensuring a broad representation.

The rationale behind this strategy was to distribute the study questionnaires effectively among teachers, capturing their perspectives on the challenges that hinder the implementation of integrative learning approaches and the requirements for developing STEM-based practices in early childhood. Based on these insights, the study was able to shape the Proposed Framework for integrative learning in early childhood.

The sample distribution was not equal across the five cities. Riyadh represented the largest group of participants, followed by Al-Ahsa (Al-Hofuf and Al-Mubarraz), while the Eastern Province cities (Dammam and Khobar) contributed smaller proportions. This unequal distribution reflects population density and the relative availability of teachers in each city.

Table 1. Demographic Characteristics of Study Participants (N = 270)

No. of Teachers	City	Percentage %	Public N (%)	Private N (%)	Academic Qualification N (%)	Experience Years
110	Riyadh	40.7	60 (54.5)	50 (45.5)	80 BA, 30 PG (27.3)	40 <5y, 50 5–10y, 20 >10y
60	Al-Hofuf	22.2	35 (58.3)	25 (41.7)	45 BA, 15 PG (25)	20 <5y, 25 5–10y, 15 >10y
45	Al-Mubarraz	16.7	25 (55.6)	20 (44.4)	35 BA, 10 PG (22.2)	15 <5y, 20 5–10y, 10 >10y
30	Dammam	11.1	18 (60.0)	12 (40.0)	22 BA, 8 PG (26.7)	10 <5y, 12 5–10y, 8 >10y
25	Khobar	9.3	14 (56.0)	11 (44.0)	18 BA, 7 PG (28)	8 <5y, 10 5–10y, 7 >10y
270	Total	100	152 (56.3)	118 (43.7)	200 BA, 70 PG (25.9)	93 <5y, 117 5–10y, 60 >10y

Ethical Considerations

Ethical principles were carefully observed throughout all stages of the study. Participation was entirely voluntary, and the teachers who took part were informed of the purpose of the research and assured that their responses would be used solely for academic purposes. Informed consent was obtained prior to data collection, and participants were given the right to withdraw at any stage without any consequences. Anonymity and confidentiality were strictly maintained. No personal identifiers such as names, school details, or contact information were collected, and all responses were treated with respect and privacy. The data were stored securely and used only by the researcher to ensure integrity and transparency. Furthermore, the study design and data collection procedures were reviewed in accordance with ethical research standards, ensuring that participants' dignity, time, and professional perspectives were valued and respected.

Data Collection Instruments

To accomplish the objectives of this study, two structured questionnaires were developed and directed to kindergarten teachers, since they are the central practitioners in applying, or facing challenges with, integrative learning and STEM-based practices in early childhood classrooms.

The process of preparing the two instruments went through systematic steps to ensure both validity and reliability. First, the scope and focus of each instrument were defined. The first questionnaire was designed to explore the challenges of applying integrative learning approaches in early childhood education, covering three main dimensions: teacher-related challenges, curriculum and activity-related challenges, and classroom environment challenges. The second questionnaire aimed to identify the requirements for activating STEM-based practices in kindergartens, and likewise consisted of three dimensions: professional development, curriculum support, and classroom and resource support.

Second, the items were drafted in light of the literature, previous studies, and practical observations, ensuring they reflected the real context of kindergarten classrooms. Third, the instruments were subjected to content validation by a panel of nine experts in early childhood education and educational measurement, whose feedback helped refine the clarity, coverage, and appropriateness of the items.

Following this, both instruments were piloted on 20 kindergarten teachers outside the main sample to ensure that all items were clear, relevant, and feasible to administer. The questionnaires were developed and administered in Arabic, as it is the native language of the participants. For items adapted from English sources, a translation and

back-translation procedure were conducted to ensure linguistic and conceptual validity. Based on the pilot data, reliability testing using Cronbach's Alpha showed satisfactory internal consistency across all dimensions.

For **Questionnaire 1** (Challenges of Implementing the Integrative Learning Approach), the reliability coefficients were:

Teacher-related challenges ($\alpha = 0.82$)
Curriculum and activity-related challenges ($\alpha = 0.79$)
Classroom environment challenges ($\alpha = 0.84$)

For **Questionnaire 2** (Requirements for Activating STEM-based Integrative Learning), the reliability coefficients were:

Professional development ($\alpha = 0.86$)
Curriculum support ($\alpha = 0.80$)
Classroom and resource support ($\alpha = 0.88$)

All values exceeded the accepted threshold of 0.70, confirming strong internal consistency for each dimension.

Both questionnaires were constructed using a five-point Likert scale (Strongly Disagree = 1 to Strongly Agree = 5), allowing teachers to express their perspectives with sufficient nuance for quantitative analysis.

To further illustrate the structure of the study instruments, the following tables present the main dimensions and the example items of the two questionnaires. **Table 2** shows the challenges of implementing the integrative learning approach, while **Table 3** highlights the requirements for activating STEM-based integrative learning in early childhood education.

Table 2. Dimensions and Items of Questionnaire 1 (Challenges of Implementing the Integrative Learning Approach)

Dimension	Items (Statements)	Scale
Teacher-related challenges	1. I lack sufficient training to design and implement integrative STEM activities. 2. Time constraints prevent me from preparing effective integrative learning tasks. 3. I face difficulty in linking content across different subjects for young children. 4. My workload and administrative duties reduce the time I can devote to preparing integrative lessons. 5. I feel anxious about applying STEM because of my limited experience with science and technology.	Likert (1–5)
Curriculum and activity-related challenges	1. The curriculum does not provide enough flexibility to incorporate integrative STEM activities. 2. Activities are often fragmented across subjects, making integration difficult. 3. The curriculum places more emphasis on rote learning than on problem-solving or critical thinking. 4. The activity books lack sufficient examples of integrative STEM learning.	Likert (1–5)
Classroom environment challenges	1. The classroom lacks adequate materials and resources to support integrative STEM learning. 2. The physical environment is not suitable for hands-on or experimental activities. 3. Large class sizes make it difficult to apply integrative learning strategies. 4. Safety concerns limit the use of practical or experimental STEM activities. 5. Limited access to digital devices reduces the opportunities for applying STEM integration. 6. The classroom schedule does not allow enough time for extended STEM projects.	Likert (1–5)

Table 3. Dimensions and Items of Questionnaire 2 (Requirements for Activating STEM-based Integrative Learning)

Dimension	Items (Statements)	Scale
Professional development	1. Teachers need continuous training programs on integrative STEM teaching strategies. 2. Workshops and professional learning communities should be provided to exchange experiences in STEM integration. 3. Teachers should be encouraged to engage in online courses related to STEM in early childhood. 4. Opportunities should be offered for attending international conferences and seminars on STEM education.	Likert (1–5)
Curriculum support	1. The kindergarten curriculum should explicitly include integrative STEM activities. 2. Guidelines and frameworks should be provided to help teachers apply integrative learning. 3. Learning outcomes should reflect competencies such as problem-solving, creativity, and critical thinking.	Likert (1–5)

Dimension	Items (Statements)	Scale
	4. Sample lesson plans and activity books should provide ready-to-use examples of STEM integration. 5. Curriculum designers should collaborate with teachers to adapt content for integrative learning.	
Classroom and resource support	1. Classrooms should be equipped with age-appropriate technological tools (e.g., tablets, robotics kits). 2. Financial support should be allocated for implementing STEM activities. 3. Classrooms should provide a safe space for hands-on activities and experiments. 4. Teaching aids and manipulatives are necessary for effective STEM-based learning. 5. The number of students per class should be reduced to allow practical STEM activities. 6. Parents and the local community should be encouraged to support and provide resources for STEM integration.	Likert (1–5)

Procedures of Data Collection and Data Analysis

In order to ensure effective data collection across a geographically diverse sample of kindergarten teachers, the two questionnaires were administered electronically using Google Forms. This method was selected because it allowed for broader access to participants distributed across the five cities involved in the study, while also ensuring convenience and ease of response for teachers. The questionnaires remained open for a period of two weeks, giving participants sufficient time to read the items carefully and provide their responses at their own pace. Regular reminders were sent to encourage participation and to maximize the response rate.

Upon closure of the data collection period, the responses were downloaded from Google Forms and systematically transferred into Excel spreadsheets by the research team. This step ensured that the data were well organized, cleaned, and ready for analysis. The prepared datasets were then imported into the Statistical Package for the Social Sciences (SPSS) for further processing.

The analysis primarily relied on descriptive statistics, including means, standard deviations, and percentages. These measures were deliberately chosen because the purpose of the study was not to compare teachers according to their qualifications, type of kindergarten, or years of experience. Instead, the aim was to capture their shared perceptions of challenges and requirements in a way that reflects the nature of early childhood education itself. This stage is characterized by play-based learning, holistic development, and the need for meaningful connections across subject areas. For this reason, descriptive analysis offered a suitable lens to understand the realities faced by teachers, without fragmenting their experiences into isolated variables.

The findings from these descriptive measures helped to identify the obstacles that limit integrative practices as well as the supports that teachers consider essential for success. These insights provided a solid foundation for developing A Proposed Framework Based on STEM, one that aligns with the integrative philosophy of early childhood learning and responds directly to the classroom realities of both teachers and children.

The findings from these descriptive measures helped to identify the obstacles that limit integrative practices as well as the supports that teachers consider essential for success. These insights provided a solid foundation for developing A Proposed Framework Based on STEM, one that aligns with the integrative philosophy of early childhood learning and responds directly to the classroom realities of both teachers and children. The descriptive analysis of both challenges and requirements enabled the study to determine the main elements of the proposed framework for integrative learning in early childhood based on STEM, as will be further detailed in the results section.

RESULTS AND DISCUSSIONS

This section presents the key findings of the study and provides a discussion of their implications in light of the research objectives. The results are organized according to the two questionnaires administered to kindergarten teachers. The first set of results relates to the challenges that hinder the implementation of integrative learning approaches, grouped under three main dimensions: teacher-related challenges, curriculum and activity-related challenges, and classroom environment challenges. The second set of results addresses the requirements for activating STEM-based integrative learning in early childhood education, structured around professional development, curriculum support, and classroom and resource support. Each set of findings is followed by a discussion that situates the results within the broader context of early childhood education and integrative learning. Finally, the section culminates in the presentation of A Proposed Framework Based on STEM, which brings together the insights of the study into a practical and context-based model for early childhood education. In Tables 4 and 5 below, the quantitative results of the two questionnaires are presented. Table 4 outlines the challenges that teachers face in implementing the integrative learning approach, while Table 5 highlights the requirements they consider essential for

Table 4. Perceived Challenges of Implementing the Integrative Learning Approach

Dimension	Item	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
Teacher-related challenges	I lack sufficient training to design and implement integrative STEM activities.	120 (44.4)	95 (35.2)	30 (11.1)	18 (6.7)	7 (2.6)
	Time constraints prevent me from preparing effective integrative learning tasks.	110 (40.7)	100 (37.0)	28 (10.4)	20 (7.4)	12 (4.5)
	I face difficulty in linking content across different subjects for young children.	105 (38.9)	90 (33.3)	40 (14.8)	22 (8.1)	13 (4.9)
	My workload and administrative duties reduce the time I can devote to preparing integrative lessons.	130 (48.1)	80 (29.6)	32 (11.9)	20 (7.4)	8 (3.0)
	I feel anxious about applying STEM because of my limited experience with science and technology.	95 (35.2)	100 (37.0)	40 (14.8)	25 (9.3)	10 (3.7)
Curriculum and activity-related challenges	The curriculum does not provide enough flexibility to incorporate integrative STEM activities.	125 (46.3)	90 (33.3)	28 (10.4)	18 (6.7)	9 (3.3)
	Activities are often fragmented across subjects, making integration difficult.	115 (42.6)	85 (31.5)	35 (13.0)	25 (9.3)	10 (3.7)
	The curriculum places more emphasis on rote learning than on problem-solving or critical thinking.	120 (44.4)	100 (37.0)	25 (9.3)	18 (6.7)	7 (2.6)
	The activity books lack sufficient examples of integrative STEM learning.	105 (38.9)	95 (35.2)	35 (13.0)	22 (8.1)	13 (4.8)
Classroom environment challenges	The classroom lacks adequate materials and resources to support integrative STEM learning.	135 (50.0)	85 (31.5)	25 (9.3)	15 (5.6)	10 (3.6)
	The physical environment is not suitable for hands-on or experimental activities.	120 (44.4)	90 (33.3)	30 (11.1)	20 (7.4)	10 (3.8)
	Large class sizes make it difficult to apply integrative learning strategies.	130 (48.1)	85 (31.5)	25 (9.3)	20 (7.4)	10 (3.7)
	Safety concerns limit the use of practical or experimental STEM activities.	115 (42.6)	95 (35.2)	30 (11.1)	20 (7.4)	10 (3.7)
	Limited access to digital devices reduces the opportunities for applying STEM integration.	100 (37.0)	105 (38.9)	35 (13.0)	20 (7.4)	10 (3.7)
	The classroom schedule does not allow enough time for extended STEM projects.	110 (40.7)	100 (37.0)	30 (11.1)	20 (7.4)	10 (3.8)

The results in **Table 4**. show that kindergarten teachers expressed a clear agreement about the existence of challenges that limit the implementation of the integrative learning approach. In almost all dimensions, the combined percentages of Strongly Agree and Agree exceeded 70 percent, which reflects a strong consensus among teachers that these obstacles are real and significant. Within the teacher-related challenges, the most prominent issue was the impact of workload and administrative duties, where more than three quarters of the teachers (77.7 percent) reported that these responsibilities reduce the time they can devote to preparing integrative lessons. A similar proportion (79.6 percent) indicated that they do not receive sufficient training to design and apply STEM-based activities effectively. In terms of curriculum and activity-related challenges, the highest concern was the lack of flexibility in the curriculum, as reported by 79.6 percent of the teachers. This was followed by the view that the curriculum continues to emphasize rote learning rather than problem-solving and critical thinking, with 81.4 percent of teachers agreeing with this statement. The classroom environment challenges recorded the highest

overall levels of agreement. More than four out of five teachers (81.5 percent) pointed to the shortage of adequate materials and resources as a major barrier. Large class sizes were also identified as a pressing issue by 79.6 percent of the participants, while 77.7 percent noted that the daily classroom schedule leaves little time for extended STEM projects. In general, these results highlight that the challenges are not confined to one area but span across teachers' preparation, the structure of the curriculum, and the realities of the classroom environment.

Table 5. Requirements for Activating STEM-based Integrative Learning

Dimension	Item	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
Professional development	Teachers need continuous training programs on integrative STEM teaching strategies.	140 (51.9)	90 (33.3)	25 (9.3)	10 (3.7)	5 (1.8)
	Workshops and professional learning communities should be provided to exchange experiences in STEM integration.	135 (50.0)	95 (35.2)	20 (7.4)	12 (4.5)	8 (3.0)
	Teachers should be encouraged to engage in online courses related to STEM in early childhood.	120 (44.4)	100 (37.0)	30 (11.1)	15 (5.6)	5 (1.9)
	Opportunities should be offered for attending international conferences and seminars on STEM education.	125 (46.3)	90 (33.3)	30 (11.1)	15 (5.6)	10 (3.7)
Curriculum support	The kindergarten curriculum should explicitly include integrative STEM activities.	130 (48.1)	95 (35.2)	25 (9.3)	12 (4.4)	8 (3.0)
	Guidelines and frameworks should be provided to help teachers apply integrative learning.	135 (50.0)	90 (33.3)	28 (10.4)	10 (3.7)	7 (2.6)
	Learning outcomes should reflect competencies such as problem-solving, creativity, and critical thinking.	140 (51.9)	90 (33.3)	20 (7.4)	12 (4.4)	8 (3.0)
	Sample lesson plans and activity books should provide ready-to-use examples of STEM integration.	120 (44.4)	100 (37.0)	30 (11.1)	15 (5.6)	5 (1.9)
	Curriculum designers should collaborate with teachers to adapt content for integrative learning.	125 (46.3)	95 (35.2)	28 (10.4)	12 (4.4)	10 (3.7)
Classroom and resource support	Classrooms should be equipped with age-appropriate technological tools (e.g., tablets, robotics kits).	135 (50.0)	95 (35.2)	20 (7.4)	12 (4.5)	8 (3.0)
	Financial support should be allocated for implementing STEM activities.	130 (48.1)	90 (33.3)	25 (9.3)	15 (5.6)	10 (3.7)
	Classrooms should provide a safe space for hands-on activities and experiments.	120 (44.4)	100 (37.0)	30 (11.1)	15 (5.6)	5 (1.9)
	Teaching aids and manipulatives are necessary for effective STEM-based learning.	125 (46.3)	95 (35.2)	28 (10.4)	12 (4.4)	10 (3.7)
	The number of students per class should be reduced to allow practical STEM activities.	140 (51.9)	90 (33.3)	20 (7.4)	12 (4.4)	8 (3.0)
	Parents and the local community should be encouraged to support and provide resources for STEM integration.	130 (48.1)	95 (35.2)	25 (9.3)	12 (4.4)	8 (3.0)

The results in **Table 5**. make it clear that kindergarten teachers strongly supported the requirements needed to activate integrative STEM learning. In almost every item, the combined percentages of Strongly Agree and Agree exceeded 80 percent, which reflects a widespread recognition among teachers that such supports are essential for effective practice.

In the professional development dimension, the highest level of agreement appeared in the call for continuous training programs, where 85.2 percent of teachers either strongly agreed or agreed. Workshops and professional communities were also highly valued, with 85.2 percent agreement, showing that teachers believe in the importance of peer learning and sharing best practices.

For curriculum support, the most notable requirement was ensuring that learning outcomes focus on competencies such as problem-solving, creativity, and critical thinking. Here, 85.2 percent of the teachers expressed agreement, confirming the need for a curriculum shift that goes beyond memorization. Likewise, teachers strongly emphasized the value of providing explicit guidelines and practical lesson plans, which would help them integrate STEM in a structured and confident manner.

In terms of classroom and resource support, the findings again showed very high levels of agreement. More than 85 percent of teachers highlighted the importance of equipping classrooms with technological tools and reducing the number of students per class to make hands-on activities feasible. Financial support and safety considerations also emerged as central requirements, reflecting the practical realities teachers face when attempting to implement STEM in early childhood settings. These results suggest that teachers see professional preparation, curriculum reform, and classroom resources as interconnected pillars. Strengthening these areas provides not only the tools but also the confidence necessary to bring integrative STEM learning to life in kindergarten classrooms

Based on the findings presented in **Tables 4 and 5**, it becomes evident that kindergarten teachers view the implementation of integrative STEM-based learning as both an aspiration and a challenge. On the one hand, they clearly recognize the importance of this approach for developing critical thinking, problem-solving, and creativity among young children. On the other hand, they face a range of obstacles that limit its application in daily classroom practice. This dual perspective underscores the urgent need for a balanced response: addressing the barriers while at the same time providing the necessary supports that teachers believe will make integrative learning possible.

Teacher-related challenges stand out as a major concern. Many teachers admitted that they lack sufficient preparation, whether in the form of training or confidence, to design and carry out STEM-integrated activities. These concerns are further reinforced by heavy workloads and administrative responsibilities that leave little room for innovation in lesson planning. At the same time, the results show that teachers are not simply pointing out problems; they are also pointing to solutions. They strongly emphasized the value of professional development, workshops, and peer learning opportunities, which suggests that with the right training and encouragement, teachers are eager to embrace integrative practices.

The curriculum emerges as another key area that requires reform. Teachers noted the rigidity of the current curriculum and its tendency to emphasize memorization rather than inquiry, creativity, and problem-solving. Such observations resonate strongly with their expressed need for explicit curriculum support, including the provision of frameworks, clear guidelines, and lesson plans that demonstrate how STEM can be meaningfully applied in early childhood education. In other words, the same area that teachers identify as a source of limitation-the curriculum-also holds the greatest potential for transformation if it is redesigned with integration in mind.

The classroom environment and resources were highlighted as both a challenge and a requirement. Teachers described the lack of materials, overcrowded classrooms, and limited time as serious barriers to applying integrative learning strategies. At the same time, they strongly advocated for well-equipped classrooms, financial support, safe spaces for experimentation, and smaller class sizes to make hands-on STEM activities realistic. The alignment between the obstacles they face and the requirements they demand suggests that teachers have a clear vision of what needs to change. Addressing these issues simultaneously would not only reduce frustration but also create the supportive conditions necessary for children to experience learning that is integrative, engaging, and developmentally appropriate.

The findings also reveal a close and interwoven relationship between the integrative learning approach in kindergarten and the principles of STEM. This relationship appears not as a simple overlap but as a deeply interconnected foundation, where each element-teachers, curriculum, and classroom environment-plays a role in preparing the ground for integrative practices. Teachers' voices highlight both the desire and the need for professional growth, while the curriculum provides the structure that can either constrain or enable innovation. The classroom, with its resources and atmosphere, becomes the living space where integration is either brought to life or stifled. Together, these dimensions show that the success of STEM-based integration in early childhood depends on the harmony of all parts, much like cultivating fertile soil where meaningful learning can take root and flourish.

The study's findings highlight that integrative STEM-based learning supports children's natural developmental characteristics. Young children learn best when they can explore, experiment, and make connections across

different ideas. By engaging in hands-on STEM activities, children develop critical thinking, creativity, and problem-solving skills in ways that match their cognitive and social development. These experiences allow children to integrate knowledge across domains, reflecting how they naturally perceive the world as interconnected rather than fragmented.

The results show that children's ability to integrate knowledge and skills depends on the support provided by teachers, curricula, and classroom environments. When teachers are well-prepared, curricula are flexible, and classrooms are equipped with appropriate resources, children can confidently connect ideas, collaborate with peers, and engage in meaningful learning experiences. Linking the study's findings to children's developmental and cognitive characteristics reinforces the practical and theoretical value of applying integrative STEM learning in early childhood education, fostering holistic development and preparing children for lifelong learning.

The Proposed Framework for Integrative Learning in Early Childhood Based on STEM Principles

The proposed framework for integrative learning in early childhood, grounded in STEM principles, emerges naturally from the voices of the teachers and the realities revealed in this study. It is not an abstract plan, but a response to the challenges they experience and the requirements they see as essential. The framework rests on five interconnected elements that together create a pathway for meaningful change. The first element focuses on teacher preparation and professional development, since no framework can succeed without confident and well-trained educators. The second emphasizes curriculum design and support, ensuring that what children learn and how they learn it reflects creativity, inquiry, and problem-solving rather than memorization. The third element is the classroom environment and resources, because even the best curriculum and training remain limited without materials, safe spaces, and manageable class sizes. The fourth element highlights the integration philosophy in early childhood education, making sure that STEM is not treated as a separate subject but as a natural extension of play, exploration, and holistic learning. Finally, the fifth element addresses monitoring, assessment, and sustainability, so that progress can be measured, practices can be improved over time, and the framework can endure as part of the educational culture. These five elements form the backbone of the proposed framework, offering a clear and practical response to the challenges identified by teachers and pointing the way toward a richer and more integrated learning experience for young children.

Teacher Preparation and Professional Development

STEM integration in early childhood is only as strong as the teachers who bring it to life. The study showed that many teachers feel unprepared to design activities that connect science, technology, engineering, and mathematics in playful and age-appropriate ways. Professional development must therefore focus not just on theory, but on practical training where teachers experiment with STEM activities themselves, learn how to scaffold problem-solving for young children, and adapt technology tools for exploration in the kindergarten setting. When teachers grow more confident in linking STEM concepts through play and discovery, integration moves from being an abstract idea to a lived classroom reality.

Curriculum Design and Support

A STEM-based integrative approach requires a curriculum that values connections across subjects rather than isolation. Teachers noted that the current curriculum often emphasizes memorization and fragmented activities. To activate STEM integration, the curriculum should provide units and lesson plans that naturally combine counting with measurement, storytelling with scientific inquiry, or building blocks with engineering design. Clear guidelines, adaptable resources, and model activities can help teachers see how STEM is not an "add-on" but a core method for engaging children in meaningful learning. This shift allows mathematics and science to be taught not as separate domains but as part of everyday problem-solving and discovery.

Classroom Environment and Resources

STEM learning thrives in environments where children can test ideas, build models, and use tools. The study highlighted barriers such as overcrowded classrooms, lack of materials, and insufficient digital access. To support integrative STEM, classrooms must be reimagined as small laboratories of exploration, equipped with age-appropriate manipulatives, simple robotics kits, tablets for digital play, and safe spaces for experiments. Reducing class sizes makes it possible for children to collaborate in small groups, while adequate funding ensures that projects are not limited by the absence of basic resources. A resource-rich environment transforms abstract STEM concepts into hands-on experiences children can see, touch, and question.

Integration Philosophy in Early Childhood Education

At its core, STEM is about integration-breaking down the walls between disciplines to solve real problems. This philosophy aligns perfectly with early childhood education, which is already holistic and play based. The results confirm that teachers value integration but need clarity on how to weave STEM into daily routines. By framing STEM as a playful context for exploration, children can count while they build, investigate while they draw, and solve problems while they play. In this way, STEM ceases to be "another subject" and instead becomes the natural language of discovery in kindergarten classrooms, where curiosity guides the learning journey.

Monitoring, Assessment, and Sustainability

To make STEM integration lasting, schools need systems that monitor progress and provide feedback. Traditional tests do not capture the creativity, collaboration, or problem-solving central to STEM. Instead, assessment tools should focus on how children explore, how they ask questions, and how they work together to design solutions. Sustainability also requires that teachers receive ongoing feedback, that school leaders support resources for STEM, and that parents are engaged as partners in children's learning. When STEM practices are assessed, celebrated, and refined, they move beyond being a short-term initiative and become part of the culture of early childhood education.

Teaching and Learning Strategies and Suggested Activities for STEM-based Integrative Learning in Kindergarten

Translating the proposed framework into practice requires a focus on the ways children actually learn in kindergarten. Early childhood education is rooted in play, discovery, and hands-on exploration, which aligns closely with the philosophy of STEM integration. Teachers can therefore design learning experiences that encourage curiosity and problem-solving while remaining age-appropriate and enjoyable.

One of the most powerful approaches is play-based STEM exploration, where children engage in guided play that introduces scientific and mathematical concepts in natural and meaningful ways. Building with blocks or LEGO, for example, not only sparks creativity but also introduces principles of balance, measurement, and design. Similarly, inquiry-based activities can encourage children to ask questions-such as why some objects float while others sink-and then experiment to discover answers through observation and reasoning.

In addition, project-based learning offers opportunities for children to work on small, integrated projects that bring STEM principles to life. Projects-like designing a paper bridge, planting seeds to observe growth, or creating simple machines from everyday materials combine science, engineering, and mathematics with creativity and collaboration. Technology can also be introduced in simple and playful ways, using tablets for interactive games or age-appropriate robots to support logical thinking and sequencing skills.

Equally important are collaborative group activities, where children learn to communicate, share ideas, and solve problems together. Working in teams to build a tower, design a shelter, or create a model of their environment nurtures both cognitive and social development. Finally, storytelling with STEM connections provides a bridge between imagination and inquiry. A story about a child who builds a boat, for instance, can lead to activities exploring floating and sinking, while a story about counting stars can spark simple mathematical investigations.

Figure 2. illustrates the proposed framework, which presents five interconnected elements-teacher preparation and professional development, curriculum design and support, classroom environment and resources, integration philosophy, and monitoring and sustainability. Together, these elements form a cohesive model that supports the implementation of integrative STEM learning in early childhood education and aligns with Sustainable Development Goal 4 (Quality Education).

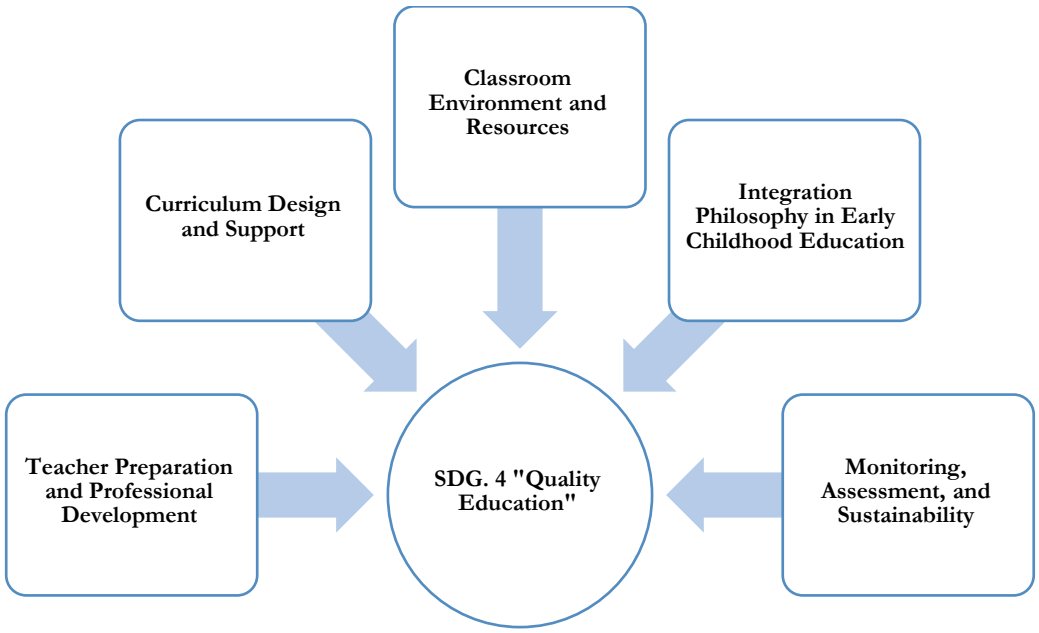

Figure **2.** The Proposed Framework for Integrative Learning in Early Childhood Based on STEM

The proposed framework aligns closely with the fourth Sustainable Development Goal (SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all). Each element of the framework reflects this goal in a practical and human-centered way. Enhancing teacher preparation and professional development ensures that all children are taught by qualified and confident educators capable of nurturing curiosity and creativity from the earliest years. Curriculum design and support promote learning experiences that are equitable, engaging, and inquiry-driven key pillars of quality education. The classroom environment and resources component reinforces the idea that every child deserves a safe, stimulating, and well-equipped space to explore and learn. The integration philosophy fosters inclusive and holistic learning where diversity, play, and discovery are valued as natural pathways to understanding. Finally, the monitoring and sustainability element embodies lifelong learning by ensuring that educational improvement continues over time.

Educational Implications for the Study

The findings of this study carry important implications for early childhood education. They show that teachers, curricula, and classrooms must work together if integrative STEM learning is to become a reality in kindergartens. For teachers, the results highlight the need for continuous professional development that equips them with the skills and confidence to design meaningful STEM activities. For curriculum developers, the study points to the importance of creating flexible programs that emphasize creativity, inquiry, and problem-solving rather than memorization. For schools and policymakers, the findings stress the value of providing resources, safe learning spaces, and manageable class sizes so that children can actively explore and experiment. At a broader level, the study suggests that when STEM is integrated into the natural rhythm of early childhood learning, it has the potential to nurture a generation of curious, creative, and confident learners. By responding to the voices of teachers and addressing the obstacles they face, education systems can build a stronger foundation for integrative learning-one that not only benefits children in the present but also prepares them for the challenges of the future.

CONCLUSION

This study set out to explore the challenges and requirements of implementing integrative learning in early childhood education through the lens of STEM, and to propose a framework that responds to the realities faced by teachers in kindergartens. The findings revealed that while teachers recognize the value of integrative STEM practices, they often encounter barriers related to limited training, rigid curricula, and insufficient classroom resources. At the same time, teachers also identified the supports they believe are essential, including professional development, curriculum flexibility, and well-equipped learning environments. By bringing these perspectives together, the study developed a proposed framework that highlights five interconnected elements: teacher preparation, curriculum design, classroom resources, the integration philosophy of early childhood, and sustainable

monitoring and assessment. This framework reflects both the aspirations of teachers and the practical conditions of early childhood classrooms, offering a roadmap for making integrative STEM learning not only possible but effective.

The study underscores that integrative learning in early childhood is not just an educational trend but a necessity. When children are given the opportunity to explore, play, and problem-solve through STEM, they develop the creativity, curiosity, and critical thinking skills needed for lifelong learning. By addressing the challenges and building on the requirements identified in this research, early childhood education can move toward a more holistic and future-oriented model that truly prepares young learners for the world they will inherit.

LIMITATIONS AND FUTURE RESEARCH

This study is not without its limitations. The data were collected from a sample of kindergarten teachers in only five cities in Saudi Arabia, which may limit the generalizability of the findings to other regions or contexts. The study also relied on self-reported questionnaires, which, while valuable for capturing teachers' perspectives, may not fully reflect actual classroom practices. In addition, the focus was on descriptive statistics rather than comparative or experimental methods, which means the results provide a broad picture of challenges and requirements but do not measure the impact of specific interventions.

The authors also acknowledge that the proposed framework developed in this study is conceptual in nature. It has not yet been applied or tested in actual kindergarten classrooms. Rather, it serves as a theoretical model informed by teachers' perspectives and designed to guide future practice and experimentation. This distinction is important, as it highlights the need for further empirical research to validate, refine, and adapt the framework in real educational settings.

Despite these limitations, the study opens important pathways for future research. Further studies could expand the sample to include a wider range of schools across different regions or compare public and private kindergarten systems in more detail. Experimental or quasi-experimental designs could also be used to test the effectiveness of specific STEM-based integrative strategies in early childhood classrooms. Another valuable direction would be to explore children's own experiences and learning outcomes when exposed to integrative STEM activities, giving voice not only to teachers but also to the learners themselves.

RECOMMENDATION

- Strengthen continuous professional development programs for early childhood teachers, focusing on practical, play-based approaches that integrate STEM principles in natural and engaging ways.
- Encourage educational policymakers to design supportive frameworks that provide teachers with time, resources, and autonomy to implement integrative learning effectively.
- Develop flexible curricula that connect science, technology, engineering, and mathematics with real-life experiences, allowing children to explore, imagine, and problem-solve through play and discovery.
- Equip classrooms with diverse and age-appropriate learning materials, digital tools, and safe spaces that foster experimentation, collaboration, and creativity.
- Foster collaboration between teachers, curriculum developers, and educational leaders to ensure that integrative STEM practices become a sustainable and evolving part of early childhood education.
- Promote ongoing assessment and reflection processes that value curiosity, creativity, and teamwork as much as academic outcomes, aligning with the vision of SDG 4: Quality Education for all.

ACKNOWLEDGMENTS

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia (Proposal Number: KFU253514).

AUTHOR CONTRIBUTIONS

A.F.I. was responsible for the conception and design of the study, data collection, analysis, and drafting of the methodology, results, and proposed framework. S.M.S. contributed to the theoretical background and literature review and supported the refinement of the discussion and implications. Both authors reviewed the final manuscript and approved it for submission. Authors have read and agreed to the published version of the manuscript.

REFERENCES

Aberz, J. (2022). "I have fought this system from the moment he stepped into school": Exploring sources of uncertainty for mothers of children with dyslexia. *American Journal of Qualitative Research, 6*(3), 212-228. https://doi.org/10.29333/ajqr/12619

AlAli, R. M., & Al-Barakat, A. A. (2024). Assessing early childhood teachers' perceptions of the role of the integrative curriculum in promoting children's learning experiences. *Edelweiss Applied Science and Technology, 8*(6), 989–1000. https://doi.org/10.55214/25768484.v8i6.2202

Al-Harbi, A. S. N. (2024). Obstacles to implementing the integrative STEM approach in teaching from the perspective of kindergarten teachers. *Arab Journal of Media and Child Culture*, 27, 295–334. https://doi.org/10.21608/jacc.2024.335551 [in Arabic]

Al-Harbi, G. H., & Zaqzouq, T. A. H. (2024). The effectiveness of STEAM-integrated educational activities in developing creative thinking fluency skills among kindergarten children. *Scientific Journal of Early Childhood Education, 2*(2), 1–31. https://doi.org/10.21608/aatm.2024.229118.1032 [in Arabic]

Almarcha, M., Vázquez, P., Hristovski, R., & Balagué, N. (2023). Transdisciplinary embodied education in elementary school: A real integrative approach for the science, technology, engineering, arts, and mathematics teaching. *Frontiers in Education*, 8, 1134823. https://doi.org/10.3389/feduc.2023.1134823

Almutairi, N. M. (2023). The effectiveness of an enrichment teaching program based on STEM approach in developing the 21st century skills of intermediate school students. *Journal of Educational and Psychological Sciences, 7*(44), 66–81. https://doi.org/10.26389/AJSRP.R070923 [in Arabic]

Al-Shahri, T. M. M. (2023). STEM program in kindergarten in Australia and the possibility of benefiting from it in Saudi Arabia. *Journal of Educational and Psychological Sciences, 7*(42), 20–42. https://doi.org/10.26389/AJSRP.H280823 [in Arabic]

Al-Sharabini, F., & Al-Tanawi, A. (2011). *Development of educational curricula.* Amman, Jordan: Dar Al-Maysarah for Publishing and Distribution. [in Arabic]

Ampartzaki, M., & Kalogiannakis, M. (Eds.). (2023). *Early childhood education: Innovative Pedagogical approaches in the post-modern era.* IntechOpen. https://doi.org/10.5772/intechopen.98078

Apriyansyah, C., Awaluddin Tjalla, Ari Saptono, Hartati, S., Jalal, F., Sukatmi, S., Ismail, M., & Lia Kurniawaty. (2024). Early childhood education: Integrative holistic early childhood development program implementation. *Child Education Journal, 6*(2), 76–87. https://doi.org/10.33086/cej.v6i2.5990

Aufseeser, D. (2019). Mothering in the context of poverty: Disciplining peruvian mothers through children's rights. *Feminist Encounters: A Journal of Critical Studies in Culture and Politics, 3*(1-2), 13. https://doi.org/10.20897/femenc/5919

Capraro, R. M., Capraro, M. M., & Morgan, J. R. (Eds.). (2013). *STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach* (2nd ed.). Rotterdam, The Netherlands: Sense Publishers.

Chavez-Luque, Y. F., & Smith Q, A. Y. (2025). The Impact of Feminist Self-Advocacy on Ambivalent Sexism in Mothers of Children with Disabilities, a Mixed Study from Peru. Feminist Encounters: A Journal of Critical Studies in Culture and Politics, 9(2), 33. https://doi.org/10.20897/femenc/16792

El-Saadany, S. T. A., Al-Nagahhi, F. M., & El-Deeb, R. M. (2020). An activity program to develop some scientific concepts among pre-kindergarten children in light of the international standards of the STEM approach. *Journal of the Faculty of Education, 79*(3), 459–487. https://doi.org/10.21608/mkmgt.2020.236240 [in Arabic]

El-Sayed, S. M. M. A., Abdelsayed, M. A. S., Homam, N. A. M. A., & Abdelhaq, Z. A. M. (2022). Effectiveness of a program based on the STEM approach in developing some self-learning skills among kindergarten children. *Journal of Childhood and Education Studies*, (23), 478–524. https://doi.org/10.21608/dftt.2022.146504.1123 [in Arabic]

Gencer, R., & Bartan, M. (2024). Investigation of the relationship between prosocial and play behaviors of 60-72 months-old children attending preschool education. *Asian Journal of Instruction, 12*(1), 17-32. https://doi.org/10.47215/aji.1409043

He, X., Li, T., Turel, O., Kuang, Y., Zhao, H., & He, Q. (2021). The impact of STEM education on mathematical development in children aged 5-6 years. *International Journal of Educational Research*, 109, 101795. https://doi.org/10.1016/j.ijer.2021.101795

Ismail, A. F., Al-Muoaeweed, O., Shahpo, S. M., Badran, A. H. A., & Elmorsy, G. N. (2025). Exploring the impact of technological pedagogical content knowledge framework on higher education: Faculty practices in emergency learning. *International Journal of Education and Practice*, *13*(1), 244–259. https://doi.org/10.18488/61.v13i1.4054

Jaber, G. K., & Habib, A. A. (2019). The integrated approach: Developmental vision and the dilemma of concept and belonging. *Misan Research Journal, 15*(29), 140–169. [in Arabic]

Kadijević, G. M. M., Mandić, D. P., & Bojanić, J. (2019). Preschool teachers' assessment of the integrative approach to environmental education. *Teaching Innovations, 32*(3), 90–99. https://doi.org/10.5937/inovacije1903090M

Karademir, A., & Yıldırım, B. (2021). A different perspective on preschool STEM education: Preschool STEM education and engineering for preservice teachers: Research article. *Journal of Turkish Science Education, 18*(3), 338–350. https://doi.org/10.36681/tused.v18i3.1063

Krogh, S. L., & Morehouse, P. (2020). *The early childhood curriculum: inquiry learning through integration (3rd ed.)*. Routledge. https://doi.org/10.4324/9780429280764

Larkin, K., & Lowrie, T. (2022). *STEM education in the early years: Thinking about tomorrow*. Berlin/Heidelberg, Germany: Springer.

MacDonald, A., Huser, C., Sikder, S., & Danaia, L. (2020). Effective early childhood STEM education: Findings from the Little Scientists evaluation. *Early Childhood Education Journal, 48*(3), 353–363. https://doi.org/10.1007/s10643-019-01004-9

Mohamed, K. A. M. (2019). Using enrichment activities based on the STEM approach to develop scientific imagination and enjoyment of science learning among kindergarten children. *Journal of the Faculty of Education, 30*(117), 39–84. https://doi.org/10.21608/jfeb.2019.59500 [in Arabic]

Nurfahma, S. A., Imran, K. S., Rohayani, F., & Qadafi, M. (2024). Implementation of the Integrative holistic program in early childhood education. *Indonesian Journal of Early Childhood Educational Research (IJECER), 3*(1), 23–35. https://doi.org/10.31958/ijecer.v3i1.12209

Olalowo, I. E. (2020). Accounts and thoughts of overage children: A Qualitative study on the physical and emotional environment of preschools in Ibadan, Nigeria. *American Journal of Qualitative Research, 4*(3), 1-13. https://doi.org/10.29333/ajqr/8390

Pattiruhu, C. M., Makulua, K., Thalib, N., Elizar, E., & Pandia, B. S. (2023). Integrative holistic learning strategies in early childhood education. *Al-Hijr: Journal of Adulearn World, 2*(4), 313–333. https://doi.org/10.55849/alhijr.v2i1.549

Ramadan, H. A. F., Al-Qaddah, A. M. A., & Ahmed, S. A. (2023). An integrated approach-based program for developing some health concepts among kindergarten children. *Journal of Early Childhood Education Faculty*, *10*(2), 854–953. https://doi.org/10.21608/maml.2023.338989 [in Arabic]

Rhodes, M. J., Visscher, A. J., van Keulen, H., & Gijsel, M. A. R. (2024). A Review of the Effects of Integrated Language, Science and Technology Interventions in Elementary Education on Student Achievement. *European Journal of STEM Education, 9*(1), 06. https://doi.org/10.20897/ejsteme/14570

Ribeirinha, T., Baptista, M., & Correia, M. (2024). The Impact of STEM Activities on the Interest and Aspirations in STEM Careers of 12th-Grade Portuguese Students in Science and Technology Curriculum. *European Journal of STEM Education, 9*(1), 21. https://doi.org/10.20897/ejsteme/15830

Şahin Kıralp, F. S., & Ummanel, A. (2023). Examination of preschool children's social emotional skills & resilience levels and father-child communication. *Asian Journal of Instruction, 11*(Special Issue), 92-110. https://doi.org/10.47215/aji.1299889

Suri, D., & Chandra, D. (2021). Teacher's strategy for implementing multiculturalism education based on local cultural values and character building for early childhood education. *Journal of Ethnic and Cultural Studies*, *8*(4), 271–285. https://doi.org/10.29333/ejecs/937

Tomić, B. P. (2019). "How could a mother do that to her children?": Filicide and maternal ambivalence in Croatian media and online discourse. *Feminist Encounters: A Journal of Critical Studies in Culture and Politics, 3*(1-2), 15. https://doi.org/10.20897/femenc/5921

Walshe, P., Commins, A., McDonnell, C., & Kelly, B. G. (2025). 'STEAM from the Start': Proposing a Conceptual Framework for the Development and Implementation of a STEAM Training Intervention for Early Childhood Educators. *European Journal of STEM Education, 10*(1), 11. https://doi.org/10.20897/ejsteme/17156

Zaenab, S. (2022). the role of pedagogical documentation in early childhood education in Indonesia. *Journal of Ethnic and Cultural Studies*, *9*(3), 194–211. https://doi.org/10.29333/ejecs/1280