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PAPER

The Influence of Utilizing Inquiry-Based Learning Strategy on Science Accomplishment of Primary Students' Stage

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ABSTRACT

This study examines the impact of inquiry-based learning (IBL) on the academic performance of third-grade students in the science unit "Materials" from the third-grade science textbook in schools under the Directorate of Education in Irbid, Jordan. A sample of 71 students was selected and separated into two groups: an experimental group of 36 students and a control group of 35 students. The empirical group used IBL, while the reference group was taught using conventional teaching techniques. An achievement test of multiple-choice questions was prepared for the study, comprising 24 items. The test's content validity was confirmed through expert judgment, and its reliability was assessed using Cronbach's alpha coefficient, which was found to be 0.83. The test's content validity was confirmed through expert judgment, and its reliability was assessed using Cronbach's alpha coefficient, which was found to be 0.83. Data were collected and processed using SPSS software. The findings showed statistically significant differences in the average scores of the study participants on the post-test based on the teaching technique variable, indicating a preference for survey-based learning. Based on these findings, the investigation recommends providing in-service and pre-service training on IBL for science supervisors and teachers at the primary education level.

KEYWORDS

inquiry-based learning (IBL), science accomplishment, primary students' stage, mobile technique

1 INTRODUCTION

In this era of rapid technological advances and expanding scientific knowledge, both technology and science education play a fundamental role in shaping the future of society [1, 2]. The 21st-century job market requires individuals who possess critical thinking skills and problem-solving abilities [3, 4]. Heightened levels of motivation and curiosity facilitate the acquisition of knowledge among young students [5].

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The current body of research indicates that incorporating inquiry-based approaches in educational settings has been shown to promote the development of 21st-century skills, especially in the areas of reasoning and critical thinking [6]. Therefore, teachers need to pay attention to providing the necessary conditions for students to start their learning actively and passionately. Teachers play a crucial role in helping students develop these skills through learning models that support active investigation. The use of an inquiry model is one of the effective learning models that can be utilized [7, 8]. This technique is best utilized in the learning process [9, 10]. It directs the learners to identify the problem and then solve it using scientific methods. Some people assume that inquiry-based learning (IBL) has little to no positive impact on students achieving academic goals in science. While some argue that traditional teaching methods are sufficient to achieve academic goals in science classes. Teaching students IBL will help them develop essential problem-solving and research skills. Essentially, it equips students with lifelong practical and problem-solving skills that enable them to thrive in the 21st century and in their future careers. In the past, science education mainly focused on students memorizing facts presented in textbooks by the general education teacher. However, it has been observed that this approach has not produced the desired results in terms of helping students with disabilities acquire scientific knowledge. In light of current perspectives in science education, it is evident that inquiry-based science instruction (IBSI) has emerged as the predominant approach for imparting scientific knowledge within the realm of general education [11, 12]. While students' cognitive abilities have long been recognized as strong predictors of science achievement, recent studies have revealed that student motivation is crucial to their performance in science [13–15]. Motivation is considered the process of initiating and maintaining goal-directed academic activity. Unfortunately, students' motivation to participate in science subjects is still low, and their interest, enthusiasm, and academic performance in science tend to decline more abruptly than in other subjects throughout the middle school years [16]. The long-term effects of low motivation and poor academic performance in science or science-related subjects may lead to inadequate preparation for success in STEM fields, including science, technology, engineering, and mathematics. Studies have shown that insufficient preparation in these fields can lead to limited career opportunities and reduced earning potential [17–22]. The concept of "inquiry-based science (IBS)" is associated with various pedagogical approaches, such as project-based instruction, activity-based instruction, hands-on learning, and discovery learning [23]. The current literature lacks a precise and unambiguous definition of inquiry-based instruction. IBL instruction involves a series of systematic procedures in which scientists and school students ask questions about the natural world and then investigate various phenomena. By engaging in inquiry-based instruction, students gain a wealth of content knowledge and a deeper understanding of relevant theories, models, principles, and concepts [24]. The Scruggs Science Standards for the Next Generation strongly emphasize the importance of argumentation, evidence, data, and analysis within the context of inquiry-based instruction [25]. The definition proposed by Scruggs and Mastropieri and the components outlined in the Next Generation Science Standards (NGSS) indicate that inquiry-based instruction involves guiding students in conducting their own experiments within a framework that emphasizes inquiry. This framework can appear in various formats. Martin-Hansen's framework outlines a range of instructional practices based on inquiry-based approaches, including structured inquiry, coupled, guided, and open-ended approaches. The updated definition of inquiry-based instruction by the National Research Council now includes minimal support considered essential for guiding inquiry and facilitating the continuum of inquiry-based instruction [26–28].

Open inquiry and scientific practice share many similarities, as both involve a process of exploration and investigation. In open inquiry, individuals are encouraged to independently explore a topic of interest, allowing for a high degree of autonomy and self-direction. This approach reflects the essence of scientific practice, in which researchers formulate their questions, design experiments, and analyze data to uncover new knowledge. On the other hand, guided inquiry takes a more balanced approach by incorporating the guidance of a teacher or facilitator. While still emphasizing the development of inquiry skills, guided inquiry provides a structured framework for learners to explore and investigate. The teacher plays a crucial role in guiding the inquiry process, providing support, asking thought-provoking questions, and facilitating discussions to enhance understanding. By incorporating both open and guided inquiry approaches, educators can cultivate a comprehensive learning experience that encourages independent thinking, critical analysis, and the acquisition of inquiry skills. Coupled inquiry can be conceptualized as a synergistic integration of guided and open inquiry methodologies. On the other hand, structured inquiry is characterized by a more directed and focused approach, which may be perceived as less engaging or stimulating for students [29, 30]. Inquiry-based science education (IBSE) is a pedagogical approach to teaching science that enables learners to construct knowledge through observation, experimentation, and teacher guidance. This approach contrasts with the conventional deductive method, in which teachers present concepts and learners passively receive information. The demand for implementing IBSE in the field of science education has significantly increased over the past twenty years. This surge can be attributed to the recognition that science, at its core, is a process driven by questioning, requiring individuals to engage in personal experiences with scientific inquiry to achieve a comprehensive understanding. Nonetheless, it is crucial to recognize the lack of precision in conceptualizing IBSE averages within the context of classroom dynamics. Scholars have carefully examined the existing literature and identified three distinct meanings associated with this term: scientific inquiry, inquiry learning, and inquiry teaching. The educational process involves the dynamic interaction between pedagogical instruction and the acquisition of knowledge, utilizing a wide range of methodologies and approaches. Within this article, the authors distinguish between two interconnected concepts: inquiry-based science teaching (IBST) and inquiry-based science learning (IBSL). This endeavor aims to provide the reader with a comprehensive explanation of the complex nature of inquiry in the field of science education. Figure 1 illustrates three distinct viewpoints regarding the concept of "inquiry" as discussed in the existing body of literature [31].

Fig. 1. Three literary interpretations of "inquiry" [31]

Recent trends in science education have focused on promoting students' active and interactive engagement in the teaching and learning process, emphasizing their central role in the educational context [32]. Therefore, science education at all levels aims to cultivate various aspects of the learner's personality, including improving their higher-order thinking skills and refining their practical skills, while urging them to be active participants, analyzers, discoverers, and interpreters inside and outside the classroom [33]. [34] suggests that scientific inquiry has focused on reforming science education. There is a focus on training students in scientific inquiry, which encompasses scientific thinking skills, scientific processes, and a positive attitude toward science and its attributes. [35] highlighted the reciprocal relationship between the nature of science and the nature of inquiry, indicating that a teacher who has a good understanding of inquiry can effectively teach students about the elements and components of scientific culture. An investigation [36] highlighted the significance of prioritizing inquiry in science education based on multiple justifications outlined in the National Science Education Standards [18]. It stated that inquiry contributes to the enhancement of learning scientific concepts, deepening understanding of the nature of science, and preparing students to independently engage in scientific inquiry [37, 38].

1.1 Definition of terms

The inquiry-based approach to learning was developed through the intellectual contributions of renowned philosophers, including Lev Vygotsky, Jean Piaget, and David Ausubel [39]. The combination of their efforts resulted in the development of constructivism, a philosophical framework for learning [40]. This theoretical perspective was later used to guide the design and development of instructional materials. The materials presented here are based on the theoretical framework of constructivism, which emphasizes the active construction of knowledge through inquiry-based approaches. These resources are designed to include hands-on activities that promote student motivation and engagement in learning scientific concepts [41]. Furthermore, it emphasizes the idea that knowledge is not simply acquired passively but is actively constructed by individuals through cognitive processes. Additionally, it emphasizes the remarkable role of social interaction in forming a shared understanding. Consequently, it is imperative for students to actively participate and be fully engaged in the learning process for meaningful learning to occur [42]. Implementing an inquiry-based approach creates a dynamic educational environment, which enhances students' understanding of scientific principles. Furthermore, implementing an inquiry-based strategy aims to enhance cognitive development and foster the cultivation of critical thinking abilities [43]. As defined by the Program for International Student Assessment (PISA), scientific literacy involves an individual's ability to acquire and apply scientific knowledge, including asking questions, gaining new knowledge, explaining scientific phenomena, and drawing evidence-based conclusions about science-related issues. Additionally, scientific literacy involves understanding the unique characteristics of science as a form of human knowledge and investigation. It also includes an individual's tendency to actively engage with science-related issues and consider scientific concepts as a thoughtful member of society [44]. Scientific inquiry can be divided into two distinct branches. As elucidated by the National Science Education Standards [45, 46], scientific inquiry encompasses a variety of methodologies that scientists employ to explore the complexities of the natural world. These methodologies involve the thorough examination of empirical evidence derived from scientific research, ultimately leading to the development of explanatory frameworks. The term "inquiry" encompasses the various activities students engage in to enhance

their understanding and acquisition of scientific concepts, as well as their grasp of the methodologies used by scientists to explore the complexities of the natural world. Scholarly literature has observed that the concept of inquiry is essential in educational and everyday contexts. This term is commonly used to describe actively seeking clarification or acquiring knowledge by formulating and presenting inquiries. According to [6], the conceptualization of IBL involves creating an educational environment in which students actively participate in open-ended, predominantly student-centered, and experiential activities. IBL is an instructional approach that places students at the focal point of the learning process, granting them agency and accountability for their knowledge acquisition by formulating, exploring, and resolving inquiries. This phenomenon may also be classified as a form of guided self-inquiry.

1.2 Objectives of the investigation

The present study aims to explore the impact of using two teaching methods (conventional techniques and IBL) on science achievement in primary grades in Jordan, specifically in the third grade.

2 LITERATURE REVIEW

The study by [47] aimed to analyze the impact of IBL on the engagement levels, attitudes, and academic performance of 5th-grade science students. The investigation involved the participation of two distinct groups of students, with a total sample size of 42 individuals (N = 42). The empirical group received inquiry-based instruction, while the reference group received conventional instruction. The study used pre- and post-tests to assess students' academic performance over a six-week research period. The study results showed that individuals exposed to IBL demonstrated superior performance on the final academic achievement test compared to those exposed to conventional learning techniques. The study conducted by [48] showed similarities to the study conducted by [47] in terms of the observed outcomes. Specifically, research found that students who participated in IBL showed better academic performance compared to their peers who were taught using traditional instructional methods. However, there was a significant difference in the timing of the teaching implementation, as it was extended by two weeks. The primary goal of the research is to investigate the impact of IBL on the academic performance of students in the field of science. The study involved 40 fifth-grade students from two separate classrooms, using purposive sampling techniques. The experimental group received instruction through IBL, while the control group received conventional instruction. The empirical inquiry lasted for eight weeks. A comprehensive assessment instrument comprising thirty items has been administered as both a post-test and a pre-test to determine the effectiveness of IBL compared to conventional educational techniques for both the experimental and control groups. Analysis of covariance (ANCOVA) was used as the selected technique for conducting statistical analysis in this study. The research findings revealed a significant correlation between the use of IBL and higher academic scores among students, compared to those who were exposed to traditional instructional methods. The study conducted by [49] further substantiated the effectiveness of inquiry-based teaching methods, not only in improving cognitive skills but also in fostering the development of systemic thinking abilities and cultivating scientific values. The primary research objectives were to evaluate the effectiveness of a science education program that employs a scaffolded inquiry approach. The research aimed to assess the impact of this teaching strategy on several

aspects, such as cognitive achievement, the enhancement of systemic thinking skills, and the fostering of scientific values among students in the preparatory stage. The study sample consisted of 85 participants who were enrolled in the third grade. The participants were separated into two groups: an empirical set consisting of 44 students and a reference set consisting of 41 students. The findings demonstrated the efficacy of the science education program when using a scaffolded inquiry approach, as evidenced by improvements in cognitive achievement, the development of systemic thinking abilities, and the promotion of scientific values. The research recommends that curriculum developers in the preparatory stage and planners at the Ministry of Education emphasize the importance of building science curricula utilizing scaffolded inquiry strategies and providing the necessary support. Furthermore, it encouraged science teachers at various educational levels to utilize scaffolded inquiry strategies in their teaching methods. In their research, [50] used data from the 3rd cycle of the Programme for International Student Assessment (PISA) for their study. The researchers utilized a three-tiered hierarchical linear modeling (HLM) approach to examine the relationship between IBSI, science achievement, and attitudes toward science. The study involved a sample of 170,474 15-year-old adolescents from 4780 educational institutions spread across 54 countries. Upon a thorough examination of various demographic parameters at the country, school, and student levels, as well as the attitudes of students towards science, the results obtained from the hierarchical linear modeling (HLM) analyses unveiled a significant inverse correlation between the implementation of IBST techniques and the level of science achievement. The research indicated a positive correlation between the implementation of IBST techniques and the development of favorable attitudes and dispositions toward science. These dispositions encompass a greater interest in and enjoyment of science learning, heightened motivation to engage with scientific concepts, and a strengthened sense of self-efficacy and self-concept in science. The examination also considers the implications for policy and practice. The investigation conducted by [51] focused on students with disabilities. Compared to the past, more students with disabilities are now receiving education in science subjects in general education classrooms. However, the effectiveness of inquiry-based teaching, which has become a prevalent practice in science education, has not been proven for these students. This review examines the impact of inquiry-based teaching on the academic performance of students with disabilities in science. Twelve studies were identified for review, and all showed improvement in science achievement through the use of inquiry-based practices. The review also emphasizes the importance of supporting disabled students in inquiry-based lessons and the need for explicit instructional components within both general and special education frameworks to improve science achievement. The Inquiry Synthesis Project aimed to combine and consolidate a body of research [52] conducted from 1984 to 2002 to address the overarching research question, "What are the effects of implementing IBSI on the academic achievements of students in grades K–12?" The chosen temporal framework builds on previous attempts to synthesize knowledge dating back to 1983 and is in line with the project's specified timeline. To investigate the research question, the project developed a conceptual framework to clarify the nature of IBSI. Additionally, a mixed-methods approach was used to investigate and analyze data on the conceptual learning of science among K–12 students. The results of a comprehensive analysis of 138 studies reveal a clear and positive pattern that supports inquiry-based instructional practices. Notably, instructional approaches that prioritize active engagement of students' cognitive processes and use data to draw meaningful conclusions have a significant advantage. The use of teaching strategies that actively engage students in scientific investigations has been more effective in improving conceptual understanding than passive techniques. It is important to acknowledge that the prevalence of standardized assessment-driven educational

systems sometimes requires the use of passive approaches. The investigation by [53] emphasized the significance of motivation in enhancing outcomes in IBL. The findings of this study provide evidence that the implementation of IBSE has a positive impact on student motivation. It facilitates their ability to engage in research practices, construct personal understanding, and gain proficiency in scientific concepts. In response to the current pedagogical approach that emphasizes inquiry, educators specializing in kindergarten and primary school education were invited, urging them to adopt and implement inquiry-based science units in their classrooms. The units in question were meticulously crafted and formulated by Romanian science educators who were actively involved in the design and development process. These units were designed and implemented as an essential part of the prestigious PROFILES FP7 project. The findings, based on feedback collected from students to assess the success of these units, demonstrated increased student engagement and motivation in science lessons. The study conducted by [54] aimed to investigate the impact of using the Sokhman inquiry technique on the academic performance of seventh-grade students in the scientific subjects of electricity and magnetism, with a focus on the seventh-grade science textbook. It also aimed to examine their retention of scientific knowledge compared to traditional teaching methods. The findings illustrated statistically significant variances in the average scores of the research subjects' performance on the post-test, which were attributed to the teaching technique variable, favoring the use of the Sokhman inquiry technique. In a separate investigation conducted by [55], an empirical study was performed to examine the effect of inquiry-based teaching techniques on academic achievement and retention of scientific knowledge in university-level biology education. The study sample consisted of 55 students randomly divided into two groups: an experimental group taught using the inquiry technique and a control group taught using the conventional technique. The researcher utilized a 40-item multiple-choice achievement test. The investigation findings revealed statistically significant variances in the achievement and retention of information in favor of the empirical group. The findings indicated that learning through the inquiry technique outperformed learning through the conventional technique by approximately 2.5 times in terms of academic achievement and about 1.5 times in terms of retention of scientific knowledge. The investigation by [56] aimed to explore the impact of using the inquiry-based teaching approach on students' physics achievement in Northern California, United States. The investigation specimen was composed of physics classes, and data collection occured over three academic years. In the first two years (1997/1998 and 1998/1999), seven classes were taught utilizing a low level of inquiry and were referred to as the "non-inquiry set." Throughout 1999/2000, two classes were taught utilizing increased inquiry techniques, which were referred to as the "inquiry set." A comparison was made between the two sets regarding student engagement throughout the investigation and their scores on the standardized physics science test, which was administered at the end of their learning and accounted for 25% of their overall grade. The findings were as follows: Utilizing the inquiry-based teaching approach did not essentially change the performance measured by Northern California's standardized physics science test. However, overall, there was an improvement in student engagement as a positive outcome of the inquiry approach, despite the lack of significant change in achievement. Based on the above information and a review of studies related to scientific inquiry, it can be concluded that various IBL techniques are more effective than other approaches in promoting student learning and the acquisition of concepts, scientific skills, and positive attitudes toward science. There is a weakness in students' grasp of scientific inquiry processes, both at the fundamental and integrative levels, across all levels of secondary and primary education, as well as in higher education, with a particular emphasis on integrative processes. It was also found that there

is a positive correlation between students' mastery of scientific inquiry processes and their scientific achievement. On the other hand, confirming the importance of IBL is essential not only for students in higher grades but also for elementary-level students.

3 METHODOLOGY

3.1 Investigation approach

The current study relies on a quasi-experimental design to explore the impact of an IBL strategy on the academic performance of third grade students in Jordan, particularly at Nahawand Primary School in the Irbid educational district. The study uses an achievement test consisting of both a reference set and an empirical set to compare the science achievement of students who were taught utilizing an inquiry-based strategy (empirical set) with those who were taught utilizing the traditional teacher-centered learning approach (reference set) over a period of seven weeks. The study employs a post-test reference set design to compare the science achievement of students who were taught using an inquiry-based strategy with those who were taught using conventional teaching methods.

3.2 Investigation participants

Nahawand Primary School in Irbid, Jordan, was deliberately chosen because of its demonstrated interest in providing all necessary facilities. This selection took place during the 2nd semester of the 2022–2023 academic year. Two grade 3 classes (totaling 71 male and female students) at the school were randomly selected for investigation. The Grade 3 students were divided into two groups: the empirical set (EG) and the reference set (CG). The empirical group consisted of 36 students, while the reference group consisted of 35 students. The experimental group was taught utilizing the IBL strategy, while the control group was taught using conventional teaching techniques as outlined in Table 1.

Table 1. Distributions, percentages, and tallies of students and sets

Set	Frequency (*f*)	Percentage (%)
Conventional (CG)	35	49.3
Inquiry-Based Learning (EG)	36	50.7
Total	71	100

3.3 Instrument of investigation (exam)

An achievement test was administered to the participants to assess and evaluate the students' science accomplishments. The science exam, which includes 24 multiple-choice questions, was designed to assess the science topic taught to grade 3 students (Unit 4: Matter). This unit comprises two sections: matter and its states, and pure substances and mixtures. The examination table of specifications (TOS) takes into account the various levels of Bloom's taxonomy, as shown in Table 2.

Table 2. Table of specifications (TOS) considering the various levels of Bloom's taxonomy

Section	Time Spent%	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	Total
Matter and its states	60	5	3	3	1	1	1	14
Pure substance and mixture	40	3	2	2	1	1	1	10
Total	100	8	5	5	2	2	2	24

Both the empirical group (EG) and the control group (CG) were taught the same science topic, utilizing either an inquiry-based learning strategy or a conventional teaching approach. The quiz consisted solely of multiple-choice questions to assess students' comprehension and application of the science concepts they had learned.

Validity: The instrument's validity was established by submitting its initial form to expert reviewers with expertise in curriculum, science teaching techniques, assessment, and evaluation. The purpose was to verify the clarity and relevance of the items to the intended field of measurement. Depending on the reviewers' feedback, necessary modifications were made, resulting in the final version of the test consisting of 24 questions.

Reliability: The reliability of the research instrument was assessed by administering the test to a different group of 32 students, separate from the original sample. The Cronbach's alpha internal consistency technique was utilized. The value of the Cronbach's alpha coefficient was 0.83. This reliability coefficient is considered suitable for the investigation.

3.4 Equivalence of the two sets: Reference and Empirical on the pre-test

To ensure the equivalence of the two sets, the averages and standard deviations (STD) for science achievement were calculated for the students in both the reference (conventional) and empirical (IBL-EG) sets on the pre-test. The findings are presented in Table 3.

Table 3. The arithmetic averages and STD of students' scores on the sets

Technique	*f*	Average	STD
Conventional	35	11.37	2.05
Inquiry-Based Learning (EG)	36	11.97	1.91

From Table 3, we observe that the average science achievement scores for the reference set (conventional) differ from those of the empirical set (IBL). To determine the statistical significance of these differences, a study was conducted using an independent sample t-test to evaluate the differences in average scores of science outcomes based on the teaching approach before implementation. The results gained have been depicted in Table 4.

Table 4. T-test for independent specimens to determine the source of variances in sets (conventional and inquiry-based learning) according to their scientific accomplishment

Technique	*f*	Average	STD	t	df	sig
Conventional	35	11.37	2.05	−1.28	69	.20*
Inquiry-Based Learning (EG)	36	11.97	1.91			

Note: *Statistical significantly at level (0.05).

From Table 4, it is evident that there were no statistically significant differences at a significance level of $p \leq 0.05$ in the mean science achievement scores based on the teaching technique. The average score for the conventional teaching technique was 11.37, whereas the average for the IBL was 11.97. The calculated statistical value (t) was –1.28, which is not statistically significant at the 0.05 level. This indicates that the reference and empirical sets had equivalent scientific accomplishments before the investigation was implemented.

4 FINDINGS

To address the research question, which asks, "Are there statistically significant differences in achievement attributed to the use of different teaching techniques (conventional technique, IBL) in primary grades?" An independent sample t-test was used to determine if there were statistically significant differences between the reference and empirical sets, as shown in Table 5.

Table 5. The arithmetic averages and STD of students' scores on the students' utilize of on the science accomplishment exam

Specialization	F	Average	STD
Conventional	35	16.97	1.76
Inquiry-Based Learning (EG)	36	18.19	2.21

Table 5 shows that the average science achievement scores for the reference set (conventional) differ from those of the empirical set (IBL) for the post-exam. To determine the statistical significance of these differences, a study was conducted using an independent sample t-test to evaluate the differences in science achievement averages based on the teaching approach prior to implementation. The results obtained have been effectively presented in Table 6.

Table 6. T-test for independent specimens to determine the source of variances in sets (Conventional and IBL) according to their scientific accomplishment

Technique	*f*	Average	STD	t	df	sig
Conventional	35	16.97	1.76	2.58	66.36	.012*
Inquiry-Based Learning (EG)	36	18.19	2.21			

Note: *Statistical significantly at level (0.05).

It is evident from Table 6 that there are statistically significant differences at a notable level ($p \leq 0.05$) in the average scores of science achievement between the control group (conventional) and the experimental group (IBL). The average score for the conventional technique was 16.97 with a standard deviation of 1.76, while the average score for the IBL was 18.19 with a standard deviation of 2.21. The calculated value of the statistical test (t) was 2.58, which is significant at the 0.05 level, indicating statistically significant variances between the reference and empirical sets, favoring the empirical set.

5 DISCUSSION

The current investigation aims to explore the impact of various teaching techniques, including conventional methods and IBL, on science achievement in

primary-grade students. The investigation findings illustrated that the group that studied utilizing the IBL technique outperformed the group that studied utilizing the conventional technique in science achievement. The current investigation's findings indicate a positive correlation between IBL and attitudes toward science, including interest and enjoyment in learning science and scientific motivation [50]. The inquiry-based approach to science learning has a positive impact on student engagement [56], which in turn enhances science achievement. A clear and positive trend supports inquiry-based teaching practices [52], especially those that focus on interpreting data, engaging students in active thinking, and using instructional strategies that actively involve students in scientific practices. IBL also stimulates student motivation [53]. Therefore, [51] argues that inquiry has become the predominant practice in science education. The results of the present study showed differences in the effect of IBL on science achievement compared to the findings of a study by [57], which demonstrated a significant negative correlation between inquiry-based science teaching (IBST) and science achievement. This difference might be attributed to the fact that the previous investigation included 54 countries, which varied in terms of educational conditions available in schools and the demographic characteristics at the student, teacher, and country levels. Consequently, students' attitudes toward science may vary. Furthermore, the findings of this investigation differed from those of a study conducted by [51], which did not demonstrate the effectiveness of IBL on students with disabilities. This indicates the need to support disabled students in participating in inquiry lessons to improve their science achievement. However, the findings of the current investigation are consistent with studies conducted by [47], which examined the impact of IBL on 5th-grade students over a six-week period, and [48], which also focused on 5th-grade students but implemented it for eight weeks. The present study is also consistent with the research conducted by [54], which focused on seventh-grade students. Additionally, the current investigation is in line with the studies conducted by [55], which examined the impact of IBST on achievement in biology instruction at the university level, and [56], which explored the impact of using an IBL on the achievement of physics students over a three-year period. These studies encompass grade levels, ranging from fifth grade to the end of secondary school and even at the university level. The latest research confirms the influence of IBST on academic achievement in early school grades, especially in the third grade. The text is too long to be saved.

6 CONCLUSION

Among the countries in the Arab world, Jordan has one of the best education systems. As an integral part of Jordanian culture and society, education plays a crucial role. The study aimed to investigate the influence of IBL on the academic performance of third-grade students in the science unit "Materials" from the third-grade science textbook. This will enhance their understanding of scientific concepts and prepare them to solve problems in their daily lives. The findings showed statistically significant differences in the average scores of the study participants on the post-test based on the teaching technique variable, indicating a preference for survey-based learning. As a result of this study, students are encouraged to engage in critical thinking about the information presented in science classes. This approach is considered one of the most modern and advanced teaching strategies in science education. Moreover, it teaches students how to solve problems.

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