International Journal of Instruction *July 2025 ● Vol.18, No.3*
e-ISSN: 1308-1470 ● www.e-iji.net *p-ISSN: 1694-609X*
pp. 79-96

Article submission code: 20241107135830 Received: 07/11/2024 Revision: 28/01/2025 Accepted: 07/02/2025 OnlineFirst: 06/04/2025

Exploring the Influence of Science Teachers Conceptions of Teaching and Learning on Technology-Enhanced Instructional Strategies

Matar Ahmed Alessa
College of Education, Curriculum and Instruction, Umm Al-Qura University, Saudi Arabia, *maease@uqu.edu.sa*

This study aimed to explore science teachers' conceptions of teaching and learning and to understand how these conceptions influence technology-enhanced instructional strategies. The sample consisted of 83 science teachers who responded to a questionnaire designed to measure their conceptions of teaching and learning and their frequent utilization of technology-enhanced instructional strategies. The collected data were analysed using various statistical methods such as descriptive statistics, correlation, and multivariate analysis of variance. Findings revealed that science teachers hold moderately traditional and highly exploratory, and constructive conceptions of teaching and learning. Participants demonstrated a high utilization of technology-based teaching strategies, such as technology-assisted instruction and multimedia. In addition, some teaching strategies, such as virtual laboratories and flipped classrooms, are still utilized by discovery-oriented and constructivist teachers. The study highlights the interplay between science teachers' conceptions of teaching and learning and their use of technology-enhanced instructional strategies.

Keywords: teaching and learning conceptions, technology-enhanced instruction strategies, teaching, learning, technology

INTRODUCTION

Teaching and learning in science education require teachers who can create an effective classroom environment. Teachers' practices and teaching skills are essential for fostering scientific achievement by equipping students with the skills needed in today's world. These practices can be "influenced by a variety of factors, including social structure, physical structure, cultural norms, epistemological orientations, and beliefs" (Hancock & Gallard, 2004, p. 281). The recent shift toward prioritizing learning over teaching requires a deeper understanding of teachers' conceptions and instructional strategies. This shift emphasizes changing teachers' roles from authoritative sources of knowledge to facilitators who adopt more constructive teaching strategies, positioning students at the center of educational practices—a key area of current research.

Constructivism leads educators to focus on how students acquire new knowledge and concepts. This approach emphasizes the interaction between experience and ideas, a

Citation: Alessa, M. A. (2025). Exploring the influence of science teachers conceptions of teaching and learning on technology-enhanced instructional strategies. *International Journal of Instruction*, *18*(3), 79-96.

dynamic that enables students to develop new insights and build knowledge. Constructivism can help teachers design classroom experiences that improve student learning and achieve intended educational goals, objectives, and outcomes (Hyslop-Margison & Strobel, 2007). These points above may lead one to reconsider the importance of active teaching and learning strategies that foster a creative and effective learning environment, considering students' backgrounds and prior experiences.

In general, studies have documented the importance of teachers' conceptions in shaping their teaching practices, which influence how they organize their teaching and learning environments (Senturk & Zeybek, 2019; Chan & Elloit, 2004). As teaching and learning shift from traditional to constructivist conceptions, teachers' own beliefs about teaching and learning play a significant role in the practical adaptation of instructional strategies (Chan & Elliot, 2004).

At the beginning of the 21st century, the landscape of education underwent a significant shift toward technology-enhanced and innovative teaching strategies, emphasizing student engagement, critical thinking, and lifelong learning skills. Educational technology aligns with pedagogical techniques that shift from traditional lecture-based instruction to student-centered learning. This integration aims to create dynamic and interactive learning environments. Kashyap (2023) emphasized that the techniques of "active participation, critical analysis, teamwork, and innovation are now the main priorities" (p. 9). Shehata et al. (2024) conducted a systematic review exploring the integration of educational technology to support student-centered learning. They found that technology supports cognitive, emotional, and motivational factors, although institutional and systemic barriers hinder the progress of technology integration.

Sahin and Yilmaz (2011) confirmed, "Teachers' beliefs play a crucial role in teaching, and these beliefs are hard to change, it is important to know what teachers' beliefs are" (p. 195). Recognizing the importance of teachers' conceptions and beliefs, Segal (1998) views these conceptions as a complex construct that can have conflicting impacts on teaching practices. For example, "teachers [may] engage in a teaching practice which they do not believe in" (Segal, 1998, p. 199). However, others argue that teachers' beliefs influence their teaching practices in the classroom (Aloqaili, 2005) and their utilization of technology-enhanced instructional strategies (Ertmer, 2005; Teo & Zhou, 2017). On the other hand, Sahin and Yilmaz (2011) noted that traditional teachers can cover subject matter more quickly than constructivist teachers. Consequently, this may reduce teachers' willingness to adopt more constructive approaches.

Alhammad (2015) indicated that Western countries adopted the constructivist approach earlier than the Arab world, including the Arabian Gulf countries. Additionally, most research on teachers' beliefs has been conducted in Western contexts (Teo & Chai, 2008). In this respect, further exploration of science teachers' conceptions about teaching and learning is particularly important in the Middle East, especially in Saudi Arabia. Additionally, researchers often examine the relationship between teachers' conceptions of teaching and learning and their acceptance of technology in educational settings (e.g., Sung et al., 2024; Abel et al., 2022; Akram et al., 2022; Teo & Zhou, 2015). Barri (2013) examined factors affecting the integration of technology into the

school curriculum in Saudi Arabia, highlighting barriers such as insufficient training, overcrowded labs, and limited equipment.

While a substantial body of research addresses this broader topic, there remains a scarcity of studies exploring specific technology-enhanced instructional strategies. This gap underscores the need for more focused investigations into specific strategies—such as the flipped classroom, multimedia integration, and virtual laboratories—that align with teachers' pedagogical beliefs and influence their instructional approaches. Thus, this study aimed to explore science teachers' conceptions of teaching and learning and their connection to technology-enhanced instructional strategies, with a focus on specific methods such as virtual laboratories, the flipped classroom, multimedia, and computer-assisted instruction. Accordingly, this study sought to answer the following four exploratory questions:

- How do science teachers perceive their own conceptions of teaching and learning?
- To what extent do science teachers utilize technology-enhanced instruction in the classroom?
- How do science teachers' conceptions of teaching and learning affect their use of technology-enhanced instructional strategies?
- How do science teachers' conceptions of teaching and learning differ by gender?

LITERATURE REVIEW

Conceptions of Teaching and Learning

Conceptions of teaching and learning have been discussed from various perspectives, referring to "the beliefs held by teachers about their preferred ways of teaching and learning and their ideas about the role of teachers and learners within the knowledge acquisition process" (Chan & Elliot, 2004, p. 819). Teaching roles vary among teachers based on their perceptions, training, attitudes, and students' needs. Mohammed (2020) noted, "teachers' beliefs seem to play a crucial role in shaping teacher classroom practices and affect students learning" (p. 576).

In general, conceptions of teaching and learning have been categorized into two approaches, which dominate teachers' beliefs and practices in the classroom environment. The first category is "traditional teaching," in which teachers rely on direct instruction to transmit knowledge, expecting students to listen, memorize, and absorb the material. Chan (2004) described the traditional approach as a transmissive approach. Teachers demonstrate the subject matter clearly, provide solutions, solve problems, and ensure students remain calm and attentive. This approach often leads students to be passive in the classroom (Chan, 2004). The absence of student questioning in traditional educational settings limits students' ability to construct knowledge or discover meaning. In addition, the teacher-centered approach lacks feedback, does not meet students' needs, and assumes all students learn at the same pace (Schwerdt & Wuppermann, 2011).

Alternatively, the constructive teaching approach focuses on student-centered learning, where teachers' roles become more progressive and facilitative. This approach emphasizes promoting student engagement, with students actively participating in the

learning process to acquire knowledge. In this approach, students have opportunities to search, explore, discuss, and share ideas in the classroom, supported by teachers' use of multiple instructional strategies as a technique to direct students' learning (Almutawa & Alkhalifah, 2015). Evidently, students' learning in this model is based on problem solving and inquiry to acquire new knowledge.

Constructivism focuses on connecting students' learning to their previous knowledge. Constructive teaching assists students in developing analytical and evaluative skills, enabling them to apply their knowledge in real-life situations. This process is essential for students' ongoing development of learning skills and deep understanding, both of which are connected to high-level cognitive skills (Ecevit and Kingir, 2022). In constructive classrooms, teachers are required to create a more interactive learning environment so that students have various opportunities to use their previous knowledge to respond to new experiences during the learning process. Jean Piaget's constructivist learning theory posits that learners actively construct knowledge by connecting new information to prior knowledge (Piaget, 1954). This approach requires students to engage actively in the learning process by interacting with peers, discussing content, and seeking new knowledge. Thus, the constructive environment helps students focus their attention on their facilitators. Qureshi et al. (2021) stated that constructivism shapes the contemporary teaching and learning process as a leading educational philosophy.

Various factors influence teachers' conceptions, including a connection between teachers' self-efficacy and their constructive beliefs about teaching and learning (Gurbuzturk & Sad, 2009; Ardic & Uslu, 2021; Shen et al., 2022). Teachers' conceptions develop based on their personal life experiences, school and learning backgrounds, and pedagogical training in teacher education (Richardson, 1996; Antonadou & Skoumios, 2013). For example, teachers' beliefs about the nature of science, the science-learning process, pedagogical content, subject matter, and their roles influence their teaching conceptions.

Another factor influencing teachers' conceptions is their epistemological beliefs. Ardic and Uslu (2021) connected constructivist teachers' conceptions to their developed epistemological beliefs, while traditional teachers' conceptions were linked to undeveloped epistemological beliefs. Notably, teachers' sophisticated epistemological beliefs influence their selection of teaching strategies (Hofer, 2008; Aldossari & Alkalid, 2021). Mohammed (2020) conducted a study on student teachers at Najran University to explore their beliefs about the nature of teaching. The study found that student teachers believe in the constructivist approach, but their teaching practices remained close to traditional methods. In addition, their mentors evaluated them as traditional teachers.

In addition, Ferrerra et al. (2024) explored the correlation between teachers' conceptions and their practices, emphasizing that comprehensive and collaborative conceptions are associated with inclusive practices. The study highlighted that female teachers scored higher than male teachers in their comprehensive and collaborative conceptions. This finding is consistent with the results of Ardic and Uslu (2021) and Ecevit and Kinger (2022), which showed that female teachers scored higher in constructivist conceptions.

In contrast, Sentiurk & Zeybek (2019) reported a significant difference based in teachers' constructivist conceptions, favoring male teachers who scored higher than female.

Science Teachers Conceptions

Science conception is viewed as a process of generating and developing scientific ideas and knowledge (Lederman, 2007). This process involves forming hypotheses based on observations of natural phenomena and evaluating them through systematic observation, experimentation, and analysis to gather new evidence. The nature of scientific evidence is subject to refinement and ongoing revision as new evidence emerges.

Tsai (2002) identified three categories of science teachers' conceptions about teaching science, including: (1) the traditional approach, in which teachers focus on transmitting knowledge, concise solutions, and memorization of facts; (2) the practicum approach, in which science teachers emphasize exploration, experimentation, and application, where the process of learning science stems from students' understanding of scientific content; and (3) constructivism, in which science teachers facilitate a learning process where students actively collaborate, solve problems, and connect new concepts to prior knowledge. These findings align with Antonadou and Skoumios (2013), who classified science teaching into "three dominant approaches to educating students in science: [including] transmission, discovery, and constructivism" (p. 70). Abdulkareem (2016) explored science teachers' beliefs on teaching science in Saudi Arabia, including the transmission, discovery, and constructivist approaches. The study reported a significant inclination toward the discovery approach.

Tsai (2002) linked many teachers' traditional views on teaching science to their experiences in school, including science classes, laboratory work, and teacher preparation programs where they developed pedagogical practices. The limited development of constructivist-oriented teaching approaches is linked to current practices, where science teachers rely on specific, familiar teaching strategies, thus reinforcing traditional ideas in the learning environment (Trumbull & Slack, 1991; Tsai, 2002). Additionally, El Takach et al., (2018) reported the importance of teachers training programs to change teachers' beliefs to more active teaching strategies. Sengul et al. (2020) found that teachers might prioritize covering the content and meeting state standards through lecturing over fostering student voice. According to the 2012 National Survey of Science and Mathematics Education in the United States, standards influence classroom instructional strategies, leading science teachers to focus on aligning their instruction with these standards (Banilower et al., 2013).

Technology-Enhanced Instructional Strategies

The integration of technology into education is not uniform, as it often depends on the subject matter and the students' age group. An and Reigeluth (2011) defined technology integration as "the use of technology for instructional purposes" (p. 55). As students ascend through different educational levels—elementary, middle, and high school—the integration of technology into the learning process becomes increasingly complex and demanding. This is due to the evolving cognitive needs of students and the advanced

requirements of the curriculum, which necessitate more sophisticated technological tools and approaches.

For educators, staying updated with technological advancements and addressing the associated challenges is crucial. Teachers must continually develop their skills in problem solving and adapt to the rapidly changing landscape of digital tools and educational technologies. The potential for technology to enhance learning in the 21st century is vast, but effective implementation requires educators to actively explore and refine new methods for fostering meaningful learning experiences.

While progress has been made, significant gaps remain, particularly in digital access and usage. The 2024 NETP highlights three divides—*digital use*, *digital design*, and *digital access*—which continue to limit educators' ability to fully integrate technology into teaching. These divides point to disparities not only in technology access but also in educators' ability to use it effectively for enhanced learning experiences (U.S. Department of Education, 2024).

To illustrate this shift in education, several factors highlight the importance of the deep learning process, which requires active student engagement through technology integration, active learning pedagogies, student-centered approaches, and interdisciplinary learning. Manalo (2020) pointed out that "deeper learning, dialogic learning, and critical thinking are essential capabilities in the 21st century environment… [alongside] problem-solving, collaborative learning, innovation, and media literacy" (p. iii). Active learning pedagogies, as one of the prominent approaches in technology-enhanced learning, emphasize the importance of student engagement through the integration of technology into teaching strategies (e.g., flipped classrooms and virtual laboratories). In addition, technology integration in education has become a critical strategy to facilitate students' learning and improve performance, as incorporating computer-assisted learning creates more engaging, interactive, and personalized experiences. Educational literature has shown that computer use in the educational setting enhances students' achievement (Sawaftah & Alfashtaki, 2010; Jaraydeh & Bany Abdo, 2012). In contrast, Seker and Kartal (2017) did not report a significant change in students' achievement from incorporating computer-assisted instruction compared to traditional teaching methods.

The integration of technology in education has revolutionized teaching and learning practices. Teaching strategies leverage various technological tools and platforms to enhance instruction, facilitate communication, and personalize learning experiences. Radford (2012) indicated that "changes in our conceptions of classroom practices result from the use of digital technologies" (p. 284). Technology-enhanced teaching strategies can have a positive influence on students' participation and self-directed learning (Rashid & Asghar, 2016). Constructive beliefs about teaching and learning positively predict teachers' attitudes toward using instructional technologies (Bahcivan et al., 2018). In addition, online collaboration tools can enhance students' learning, motivation, and engagement in science education (Ates & Koroglu, 2024).

One innovative technology-enhanced instructional strategy is the virtual laboratory that offers an interactive platform for students to perform experiments and explore scientific content in a simulated environment. Virtual laboratories replicate traditional laboratory

settings through computer-based simulations, providing students with opportunities to engage in scientific experimentation in a virtual environment. Byukusenge et al. (2022) found that virtual labs and animations enhanced students' learning and performance, highlighting the importance of incorporating virtual labs to improve students' understanding through interactive simulations and real-world examples.

The flipped classroom is another example of a technology-enhanced instructional strategy that focuses on reversing the traditional teaching model by having students first encounter new content outside the classroom, often through videos, reading, or online materials. In the classroom, students then engage in activities such as discussions, problem solving, and cooperative learning to deepen their understanding of scientific content. This process allows for more active participation and learning through hands-on activities and exploration. The flipped classroom promotes a high level of student-teacher interaction, positively influencing students' achievement (Sezer, 2017), learning emotions (Jdaitawi, 2020), and critical thinking skills (Alshahri & Aldaees, 2019).

Computer-assisted instruction and multimedia are often used in the context of educational technology, but these strategies refer to different concepts with some overlap. Computer-assisted instruction broadly refers to using digital tools to support teaching and learning through activities such as delivering lessons, providing exercises, and accessing information and content. Specifically, "it refers to the teaching process in which a computer is used to enhance a student's education, or instructional material presented by means of a computer or computer systems" (Mohammed, 2014, p. 101). For years, computer-assisted instruction has served as an effective teaching tool, offering an engaging learning environment and facilitating deeper conceptual exploration among students in their own learning (Tsai et al., 2004). Teachers' use of computers in teaching settings depends on their training to utilize modern teaching aids (Zupanec et al., 2017).

Multimedia in teaching and learning focuses on using videos and animations to engage multiple senses and help students visualize processes, such as cell division, water cycling, or other scientific concepts. Educational media denotes communication channels that transmit content with a clear instructional objective. These channels are primarily employed to facilitate learning and teaching. Despite varied personal definitions of multimedia, it "is classified as any combination of text, graphics, sound, animation, and video delivered and controlled by the computer" (Mukherjee, 2018, p. 245). Multimedia content contributes to enhancing students' learning experiences (Krishnasamy et al., 2020), cognitive achievement (Omar, 2014), and motivation (Li et al., 2014; Omar, 2014; Liu et al., 2009). Abdulrahman et al. (2020) conducted a systematic review on multimedia tools, finding that effectively integrating multimedia in education requires a comprehensive understanding of technology and the various multimedia elements necessary to accurately convey learning concepts.

METHOD

The Sample

The study took place in Alqunfutha Governorate, Saudi Arabia, using a convenience sample of 83 science teachers. Of the participants, 64 were male and 19 were female, all

of whom responded to the study questionnaire. The participants represented 28.7% of the target population, with teaching experience ranging from less than 5 years to more than 20 years, primarily at elementary and middle schools. The schools were located in diverse settings, including suburban and rural areas.

The Procedure

After obtaining the research approval, the online questionnaire link was distributed to science teachers, accompanied by three weekly reminders. Participants were informed that their responses would be kept confidential, combined with others, and used solely for scientific research in compliance with human subjects' protection protocols.

Research Instrument

In this study, the "Conception of Teaching and Learning Questionnaire" (Teo & Chai, 2008) was adapted, modified, and translated into Arabic to explore participants' perceptions of teaching and learning. Since its validation, the CTLQ has been widely used in studies to gather data on teachers' conceptions of teaching and learning (e.g., Chai et al., 2013; Igwebuike et al., 2013; Ardic & Uslu, 2021). The modifications included adding a third section focused on the discovery conception of teaching and learning (Antonadou & Skoumios, 2013; Tsai, 2002). The second dimension included four technology-enhanced instructional strategies—computer-assisted instruction, multimedia, virtual laboratory, and flipped classroom—through which science teachers evaluated their classroom use on a five-point Likert scale. Boone and Boone (2012) emphasized that interval scale data, such as Likert-scale data, provide meaningful interpretations by reflecting the proportional interval between values on the scale. The researcher applied the interpretation rule for means based on a five-point Likert scale, as shown in Table 1.

Table 1
A summary of means distribution based on five likert scale and degree

Means Range	Degree
1.00 – 1.79	Very Low
1.80 – 2.59	Low
2.60 – 3.39	Moderate
3.40 – 4.19	High
4.20 – 5.00	Very high

Data Analysis

The collected data were transferred into Statistical Package for Social Sciences (SPSS) version 29.0. The analysis began with data screening, including checks for the normality, validity and reliability of the instrument. Correlation analysis was performed to test the relationships between variables, and the hypothesis testing was conducted at a significant level of 0.05. Additionally, a multivariate analysis of variance (MANOVA) was conducted to examine the effect of gender on science teachers' conceptions of teaching and learning.

Validity and Reliability

Several specialists in the Department of Curriculum and Instruction reviewed and verified the validity of the instrument, and their feedback helped the researcher make

necessary adjustments to the items. The researcher determined the instrument's reliability using Cronbach's alpha and the total correlation of scale items, using the assistant of SPSS. Table 2 presents the reliability estimates for all dimensions, which were high: traditional conception (0.83), discovery conception (0.88), and constructivist conception (0.90).

Table 2
Summary of cronbach's alpha for all measurement scales

Dimension	Reliability Coefficient (Cronbach's Alpha)	Item Numbers
Traditional Conception	0.83	14
Discovery Conception	0.88	11
Constructivist Conception	0.90	11

FINDINGS

To answer the first research question, "How do science teachers perceive their conceptions of teaching and learning?" descriptive statistics were used to analyze science teachers' responses to the survey items. As shown in Table 3, a comparison of the means for science teachers' conceptions of teaching and learning revealed that respondents perceived high levels of constructivist and discovery conceptions. The overall means (M) were 4.42 and 4.35 with standard deviations (SD) of 0.438 and 0.474, respectively. The traditional conception of teaching and learning was rated as moderate, with an overall mean of 2.60 and SD of 0.505.

Table 3
Means and standard deviation of teaching and learning conceptions

Variables	M	SD	N	Degree
Traditional Conception	2.60	0.505	83	Moderate
Discovery Conception	4.35	0.474	83	Very High
Constructivist Conception	4.42	0.438	83	Very High

To answer the second research question and specify science teachers' use of technology-enhanced instructional strategies, the frequency of these strategies was computed and analyzed. As shown in table 4, the most frequently utilized technological teaching strategies were computer-assisted instruction and multimedia use in the classroom (M = 4.46 and 4.31, respectively). Participants evaluated these two strategies as very frequently used in the classroom. The second group of strategies, which science teachers used moderately, included the flipped classroom and virtual laboratory (M = 3.33 and 2.87, respectively).

Table 4
Frequencies, means, standard deviation, and ranks of science teachers responses to the utilization of technology-enhanced instructional strategies

N	Technology-Enhanced Instructional Strategies	Always Used	Sometimes Used	Seldom Used	Rarely Used	Not Used	M	SD	Degree
1	Computer-Assisted Instruction	47	27	9	0	0	4.46	0.68	Very high
2	Multimedia	41	27	15	0	0	4.31	0.77	Very high
3	Virtual Laboratory	7	17	31	14	14	2.87	1.18	Moderate
4	Flipped Classroom	9	29	31	8	6	3.33	1.08	Moderate

To address the third research question, "How do science teachers' conceptions of teaching and learning affect their use of technological-enhanced instructional

strategies?" the study findings revealed relevant relationships. The study findings revealed a significant negative relationship between science teachers' traditional conception and their use of technology-enhanced instructional strategies, specifically virtual laboratory and flipped classroom (r = -0.208, p = 0.03 and -0.265, p = 0.008, respectively). These findings indicate that the use of technology-enhanced teaching strategies decreases as science teachers' traditional conception of teaching and learning increases. There was a significant positive relationship between science teachers' discovery conception and their use of technology-enhanced instructional strategies, specifically virtual laboratory and flipped classroom (r = 0.330, p = 0.001 and 0.270, p = 0.007, respectively). In addition, a significant positive relationship was found between science teachers' constructivist conception of teaching and learning and their use of technology-enhanced instructional strategies, specifically virtual laboratory and flipped classroom (r = 0.293, p = 0.004 and 0.217, p = 0.02, respectively). As shown in Table 5, computer-assisted instruction and multimedia strategies did not have a statistically significant relationship with any of the three conceptions of teaching and learning. As a result, the analysis showed that computer-assisted instruction and multimedia strategies were used at a high frequency, regardless of teaching and learning conceptions.

Table 5
Summary of correlation analysis

N	Technology-enhanced Instructional Strategies	Traditional T&L Conception	Discovery T&L Conception	Constructivist T&L Conception
1	Computer-Assisted Instruction	-0.123	0.132	0.162
2	Multimedia	-0.015	0.076	0.005
3	Virtual Laboratory	-0.208*	0.330**	0.293**
4	Flipped Classrooms	-0.265**	0.270**	0.217*

To answer the fourth question, "To what level do science teachers differ in teaching and learning conceptions based on their gender?", the study analyzed gender-based differences. Table 6 presents the findings from the analysis regarding the relationship between male and female science teachers in terms of their teaching and learning conceptions. There was not a statistically significant difference by gender in traditional, discovery, and constructivist teaching and learning conceptions, with p>0.05. In addition, there is evidence to suggest potential gender-related trends in traditional *F* (1.81) = 3.004, p = 0.087, partial eta squared = 0.036, and constructivist *F* (1.81) = 2.763, p = 0.100, partial eta squared = 0.033, conceptions of teaching and learning that warrant further exploration.

Table 6
Demographic summary by participants' gender

Variable	Gender	*M*	Sd	n	F	P	Partial eta squared
Traditional Conception	Male	2.31	0.52	64	3.004	0.087	0.036
	Female	2.09	0.42	19			
Discovery Conception	Male	4.40	0.47	64	1.826	0.180	0.022
	Female	4.23	0.49	19			
Constructivist Conception	Male	4.47	0.42	64	2.763	0.100	0.033
	Female	4.28	0.46	19			

DISCUSSION

The current study aims to explore teachers' conceptions of teaching and learning in the Alqunfutha Governorate in Saudi Arabia. The study's findings indicate that science teachers tend to adopt a discovery-based and constructivist conception of teaching. A possible interpretation of these findings relates to the inherent nature of science education, as scientific teaching methods themselves are discovery-based and constructivist in nature (Ladachart, 2021). In general, if science teachers effectively align their teaching with the fundamental principles of science, they are more likely to adopt deeply active teaching strategies. This study contributes to the literature by demonstrating that science teachers can hold discovery-oriented and constructivist conceptions of teaching and learning while still retaining some traditional conceptions. This finding aligns with Ladachart's observation that "it is likely individual science teachers hold a constructivist view of teaching and learning but do not completely abandon a traditional view" (p. 11). A possible interpretation of this finding relates to the nature of the curriculum and learning objectives, which retain some traditional strategies. Eggen and Kauchak (2011) pointed out that there is no universally optimal method for teaching, as certain learning objectives are more effectively achieved through teacher-centered approaches. As discussed in the literature, curriculum standards play a significant role in influencing teachers' choices of instructional strategies to attain mandated educational objectives (Sengul et al., 2020; Banilower et al., 2013). In Saudi Arabia, Abdulkareem (2016) found that science teachers predominantly adopted discovery-oriented conceptions of teaching and learning, while showing a somewhat lower inclination toward constructivist approaches. In contrast, perceptions favoring traditional teaching methods were observed at lower levels among these teachers. These contradictory views on teaching and learning indicate a clear preference for instructional strategies that emphasize exploration, inquiry, and student-centered learning over more traditional, didactic approaches.

The study aims is to explore the influence of science teachers' conceptions on their use of technology-enhanced instructional strategies. The study's findings suggest an inverse relationship between science teachers' traditional conceptions of teaching and learning and their use of technology-enhanced instructional strategies. In other words, as science teachers hold more traditional conceptions of teaching and learning, they are less likely to employ technology-enhanced strategies that involve active participation or student-centered learning. The traditional conception of teaching and learning emphasizes (1) teacher-centered instruction, where the teacher is the primary source of knowledge and students are passive recipients, and (2) the use of lecture-based methods and standardized tests. A fixed curriculum relies heavily on a prescribed structure, offering little flexibility.

On the other hand, technology-enhanced instructional strategies focus on supporting and enhancing students' learning and achievement, fostering active participation and engagement as essential aspects of active learning and a constructivist approach. Effective student learning is primarily supported by collaborative learning, problem-based learning, interactive media, and technology integration. Technology-enhanced instructional strategies contradict traditional conceptions of teaching and learning,

which primarily center on transferring knowledge to students. The study's findings align with previous literature, suggesting that teachers' constructivist beliefs are positively associated with their attitudes toward using instructional technology (Bahcivan et al., 2017).

According to the study's findings, most participating science teachers described themselves as having discovery-based and constructivist conceptions. Computer-assisted instruction and multimedia integration were extensively used by all science teachers, with usage ranging from frequent to consistent, while none of the participants reported not using these tools at all. This finding underscores the importance of rethinking the effective application and utilization of technology in teaching and learning. Beetham and Sharpe (2007) argued that technology has been used to support traditional teaching methods, enhancing instructional strategies in ways that are not yet transformative. In general, teachers who possess a traditional conception of teaching and learning are less likely to apply technology to facilitate student-centered learning (Ertmer, 2005; Teo & Zhou, 2017).

On the other hand, computer-assisted instruction focuses on the application of computers to deliver educational content and assist learners in acquiring new skills. Instructors' roles in computer-assisted instruction primarily involve content creation and support, whereas their roles in virtual laboratories and flipped classrooms revolve around facilitation and guidance, approaches advocated for constructivist learning. Even though constructivist teachers use technology more frequently in their classrooms, traditional teachers often use technology as a tool for knowledge transmission. Teachers' perceptions of teaching and learning play significant roles in adapting technology within classrooms (Hixon & Buckenmeyer, 2009). In contrast, virtual laboratories were negatively correlated with traditional teaching conceptions, as they typically involve experimental activities that are at odds with traditional methods. Traditional science teachers may avoid virtual labs because these tools provide less direct control for teachers. Moreover, Erdogan and Dede (2015) argued that while computer technologies enhance educational quality, effective implementation is fundamentally tied to underlying teaching and learning theories. This perspective emphasizes the need to account for teachers' conceptual frameworks regarding the integration of technology in the classroom.

According to the study findings, there was no statistically significant difference between male and female science teachers' conceptions of teaching and learning, including traditional, discovery, and constructivist conceptions. The study suggests that gender does not play a significant role in how science teachers align with teaching and learning conceptions. Specific analyses revealed that male science teachers had higher mean scores across on all three conceptions. In contrast, other studies found that female teachers scored higher in the constructivist approach (Ardic & Uslu, 2021; Ecevit & Kinger, 2022). In this regard, further exploration of gender differences is essential to address this discrepancy, as the current study was conducted in a different educational setting, potentially influenced by cultural differences, educational policies, and teaching contexts.

CONCLUSION

The study provides insight into the pedagogical orientations of science teachers and their implications for classroom practice. It identifies an inverse relationship between science teachers' traditional conceptions of teaching and learning and their adoption of technology-enhanced instructional strategies. The findings indicate that science teachers tend to embrace discovery-based and constructivist conceptions of teaching and learning. This suggests a proclivity toward methods that promote student engagement, inquiry, and active knowledge construction, such as virtual laboratories and flipped classrooms, which are hallmarks of technology-enhanced instructional strategies.

There are two implications arising from the current study. Science teachers exhibit discovery-based and constructivist conceptions while still maintaining a moderate traditional approach, which underscores the need to explore potential obstacles that influence their decisions to adopt more technology-enhanced instructional strategies in the classroom. In addition, teachers who hold traditional, discovery-based, and constructivist conceptions of teaching and learning increasingly employ computer-assisted instruction and multimedia. However, a critical need remains to examine the specific classroom practices associated with the application of these technology-based teaching strategies. Understanding how these conceptions influence teachers' real-world integration of technology in the classroom is essential for identifying effective methods and ensuring that these tools are both present and meaningfully implemented to enhance students' learning outcomes.

REFRENCES

Abdulkareem, S. A. (2016). The impact of science teachers' beliefs on teaching science: the case of Saudi science teachers. *Journal of Education and Learning, 5*(2), 233-249. Doi: 10.5539/jel.v5n2p233

Abdulrahman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T. Olawoyin, L.A., Mejabi, O. V. Imam-Fulani, Y. O. Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon, 6*, 1-14, https://doi.org/10.1016/j.heliyon.2020.e05312

Abel, V. R., Tondeur, J., Sang, G. (2022). Teacher perceptions about ICT integration into classroom instruction. *Education Science, 12*(609), 1-14. https://doi.org/10.3390/edusci1290609

Akram, H., Abdelrady, A. H., Al-adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, 1-9. Doi: 10.3389/fpsyg.2022.920317

Aldossari, A. T. & Alkalid, J. K. (2021). Epistemological of secondary school teachers in teaching practices based on the grounded theory. *Cypriot Journal of Educational Sciences, 16*(6), 2930-2945.

Alhammad, K. (2015). A Conceptual Framework for Re-Shaping Science Education in Saudi Arabia. In N. Mansour & S. Al-Shamrani, (eds). *Science Education in the Arab Gulf States. Cultural and Historical Perspectives on Science Education*. (pp. 121-136). Sense Publishers, Rotterdam. https://doi.org/10.1007/978-94-6300-049-9_6

Mutawa, D. A. & Alkhalifah, H. J. (2015). *Effective teaching strategies.* Al-Mutanabbi Bookshop.

Aloqaili, A. S. (2005). The theoretical and practical orientations of Arabic language teachers in Riyadh and their relationship to constructivist theory. *The Educational Journal, 19*(76). https://doi.org/10.34120/joe.v19i76.1787

AlShahri, F. M. F., & AlDais, S. N. I. (2019). The effectiveness of flipped classroom strategies in developing critical thinking skills among second-grade middle school female students studying science in the Kingdom of Saudi Arabia. *Al-Madinah International University Journal (Majmaa),* (28). Retrieved from http://ojs.mediu.edu.my/index.php/majmaa/article/view/2206

An, Y. & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms: K-12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education, 28*(2), 54-62.

Antonadou, P. & Skoumios, M. (2013). Primary teachers' conceptions about science teaching and learning. *The International Journal of Science in Society, 4*, 69-82.

Ardic, S. & Uslu, O. (2021). Examining the variables affecting primary teachers' teaching and learning approaches with a structural equation model. *Education and Science, 46*(208), 31-54. Doi:10.15390/EB.2021.10143.

Ateş, H., & Köroğlu, M. (2024). Online collaborative tools for science education: Boosting learning outcomes, motivation, and engagement. *Journal of Computer Assisted Learning, 40*(3), 1052–1067. https://doi.org/10.1111/jcal.12931

Bahcivan, E., Gunes, E. & Ustundag, M. (2018). A comprehensive model covering prospective teachers' technology use: the relationships among self, teaching and learning conceptions and attitudes. *Technology Pedagogy and Education, 27*(3), 1-18. Doi:10.1080/1475939X.2018.1479296.

Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education.* Chapel Hill, NC: Horizon Research, Inc.

Barri, M. A. (2013). The integration of technology into school curriculum in Saudi Arabia: Factors affecting technology implementation in the classroom. A dissertation submitted to the University of Kansas.

Beetham, H. & Sharpe, R. (2007). An introduction to rethinking pedagogy for a digital age. In Helen Beetham & Rhona Sharpe (Editors). Rethinking pedagogy for a digital age. Routledge: New York, NY

Boon, H. N., & Boone, D. A. (2012). Analyzing Likert Data. *The Journal of Extension, 50*(2), article 48. https://doi.org/10.34068/joe.50.02.48.

Byukusenge, C., Nsanganwimanam & Tarmo, A. P. (2022). Effectiveness of virtual laboratories in teaching and learning biology: A review of literature. International Journal of Learning, *Teaching and Educational Research, 21*(6), 1-17. https://doi.org/10.26803/ijlter.21.6.1

Chai, C. S. Chin, C. K., Koh, J. H., & Tan, C. L. (2013). Exploring Singaporian Chinease language teachers' technological pedagogical content knowledge and its relaationaship to te teachers' pedagogical beliefs. *The Asia-Pacific Education Researcher, 22*(4), 657-666. Doi: 10.1007/s40299-013-0071-3

Chan, K. (2004). Preservice teachers epistemologyical beleifs and conceptions about teaching and learning: Cultural implications for research in teacher education. *Australian Hournal of Teacher Education, 29*(1). http://dx.doi.org/10.14221/ajte.2004v29n1.1

Chan, K. Elliott, R. G. (2004). Relational analysis of personal epistemology and conceptions about teaching and learning. *Teaching and Teacher Education, 20*(8), 817-831. https://doi.org/10.10.1016/j.tate.2004.09.002

Ecevit, T. & Kingir, S. (2022). Primary student teachers' teaching-learning conceptions, attitudes and self-efficacy beliefs toward science teaching. *Journal of Turkish Science Education, 19*(3), 773-785. Doi: 10.36681/tused.2022.149.

Eggen, P. Kauchak, D. (2011). *Strategies and models for teachers: teaching content and thinking skills*. (6th edition). Pearson.

El Takach, S., Ayoubi, Z., & Rawas, M. (2018, March). Using drawings to investigate Lebanese in-service science teachers' views on the teaching and learning process. *In Proceedings of at the Multidisciplinary Academic Conference*. (pp. 96-111), MAC Prague Consulting Ltd.

Erdoganm Y. & Dede, D. (2015). Computer assisted project-based instruction: the effects on science achievement, computer achievement and portfolio assessment. *International Journal of Instruction, 8*(2), 177-188. Doi:10.12973/iji.2015.8214a

Ertmer, P. (2005). Teacher pedagogical beleifs: the find frontier in our quest for technology integration? *ETR&D 53*(4), 25-39.

Ferreira, M., Marques, A., & Santos, S. (2024). Foundations of teaching and learning a study with teachers on conceptions and pedagogical practices. *International Journal of Instruction*, 17(2), 67-84. https://doi.org/10.29333/iji.2024.1725a

Gurbuzturk, O. & Sad, S. N. (2009). Student teachers beliefs about teaching and their sense of self-efficacy: A descriptive and comparative analysis. *Inonu University of Faculty of education. 10(3), 201-226.*

Hancock, E. S. & Gallard, A. J. (2004). preservice science teachers' beliefs about teaching and learning: the influence of K-12 field experience. *Journal of Science Teacher 15*(4), 281-291.

Hixon, E., & Buckenmeyer, J. (2009). Revisiting Technology Integration in Schools: Implications for Professional Development. *Computers in the Schools*, *26*(2), 130–146. https://doi.org/10.1080/07380560902906070

Hofer, B. K. (2004). Epistemological understanding as a metacognitive process: thinking aloud during online searching. *Educational Psychologist, 39*(1), 43-55.

Hyslop-Margison, E. J. & Strobel, J. (2007). Constructivism and education: misunderstandings and pedagogical implications. *The Teacher Education, 43*(1), 72-86. Doi:10.1080/08878730701728945.

Jaraydeh, Y. & Bany Abdo, M. O. (2012). The impact of computer use on seventh grade students' achievement. *Almanarah Journal for Research Studies, 2012*(24), 103-119. Doi: 10.21608/MBSE.2012.145599

Jdaitawi, M. (2020). Does flipped learning promote positive emotions in science education? A comparison between traditional and flipped classroom approaches. The Electronic Journal of e-learning, 18(6), 516-524. Doi: 10.34190/JEL.18.6.004

Kashyap, S. (2023). Innovative teaching-learning practices: a paradigm shift. In Kumar, P., Gupta, A., & Budarina, A. O. (Eds). *Innovative teaching learning practices: a paradigm shift*. (pp. 8-16). Global Academy.

Krishnasamy, S., Ling, L. S., & Kim, T. C. (2020). Improving learning experience of probability and statistics using multimedia system. iJET, 15(1), 77-87.

Ladachart, L. (2021). Conceptions about teaching and learning that influence Thai preservice biology teachers' orientations to teaching science. *Curriculum Perspectives, 41*(3), 3-15. https://doi.org/10.1007/s41297-020-00118-0

Lederman, N. G. (2007). Nature of science: past, present, and future. In S. k. Abell and N. G. Lederman, & D. Hanucin (Eds.). *Handbook of research on science education*. (pp. 831-879). Routledge.

Li, Y. W., Mai, N., & Tse-Kian, N. (2014). Impact of learner-centered teaching environment with the use of multimedia-mediated learning modules in improving learning experience. *Journal Technology. 68*(2), 65-71.

Liu, M., Toprac, P., & Yuen, T. T. (2009). What factors make a multimedia learning environment engaging: a case study? In R. Zheng. (Ed.). *Cognitive effects of multimedia learning.* (pp. 173-192). Information Science Reference: Hershey, PA.

Manalo, E. (2020). Establishing a case for sharing research-based instructional strategies. In Deeper learning dialogic learning, and critical thinking: research-based strategies for the classroom. Taylor & Francis. (p.1-13).

Mohammed, A. A. & Al-Akadm A. M. (2014). Effectiveness of computer-assisted instruction on enhancing the level of motor balance in children with mild intellectual disabilities. *The European Journal for Sport Sciences Technology, 3*(1), 100-107.

Mohammed, S. G. (2020). Student teachers in Najran University beleifs' about teaching and its influence on their teaching practice. *Dirasat: Human and Social Sciences, 28*(5), 573-598.

Mukherjee, S. (2018). Role of multimedia in education. Edelweiss Apllied Science and Technology, 2(1), 245-248.

Omar, A. M. (2014). The effect of using computer multimedia in teaching science on developing cognitive achievement, science processes, and achievement motivation

among slow learners in the first preparatory grade. *Educational Journal of Sohag University, 37*(37), 269-323.

Piaget, J. (1954). The construction of reality in the child. Basic books Inc.

Qureshi, M. A., Khaskheli, A., Qureshi, J. A., Raza, S. A., & Yousufi, S. Q. (2021). Factors affecting students' learning performance through collaborative learning and engagement. *Interactive Learning Environments, 31*(4), 2371–2391. https://doi-org.sdl.idm.oclc.org/10.1080/10494820.2021.1884886

Radford, L. (2012). *On the cognitive, epistemic, and ontological roles of artifacts*. In G. Gueudet, B. Pepin, & L. Trouche (Eds.). *From text to 'lived' resources*. (pp. 283-288). Springer.

Rashid, T. & Asghar, H. M. (2016). Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations. *Computers in Human Behavior*, 63, 604-612. https://doi.org/10.1016/j.chb.2016.05.084

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.). *Handbook of research on teacher education*. 2ed edition, (pp. 102-119). New York: Macmillan.

Sahin, S. & Yilmaz, H. (2011). A confirmatory factor analysis of the teaching and learning conceptions questionnaire (TLCQ). *Journal of instructional Psychology, 38*(3), 194-200.

Sawaftah, W. A. & Al-Fashtaki, H. A. (2010). The impact of teaching biology with computer-assisted instruction (CAI) on the achievement of science students at the teachers college in Tabuk and their attitudes toward computer use. *Damascus University Journal for Educational and Psychological Sciences, 26*(1,2), 377-435. Retrieved from http://search.mandumah.com/Record/57450.

Schwerdt G, Wuppermann, A. C. (2011). Is traditional teaching really all that bad? A within-student between-subject approach. *Economics of Education Review*, *30*(2):365-379. doi: 10.1016/j.econedurev.2010.11.005.

Segal, S. (1998). The role of contingency and tension in the relationship between theory and practice in the classroom. *Curriculum Studies, 30*(2), 199-206.

Seker, R. & Kartal, T. (2017). The effect of computer-assisted instruction on student achievement in science education. *Turkish Journal of Education, 6*(1), 17-29. https://doi.org/10.19128/turje.279699

Sengul, O., Enderle, P. J., & Schwartz, R. S. (2020). Science teachers' use of argumentation instructional model: linking PCK of argumentation, epistemological beliefs, and practice. *International Journal of Science Education*, *42*(7), 1068–1086. https://doi-org.sdl.idm.oclc.org/10.1080/09500693.2020.1748250

Senturk, C. & Zeybek, G. (2019). Teaching-learning conceptions and pedagogical competence perecptions of teachers: A correlational research. A study presented at the International Cogresses on Education ERPA (June, 2018) in Istanbul, Turkey. Doi:10.17810/2015.92.

Sezer, B. (2017). The effectiveness of a technology-enhanced flipped science classroom. *Journal of Educational Computing Research, 55*(4), 471-494. Doi: 10.1177/0735633116671325.

Shehata, B., Tlili, A. Huang, R., Adarkwah, M. A., Liu, M., & Chang, T. (2024). How are we doing with student-centered learning facilitated by educational teachnologies? A systematic rebiew of literature review. *Education and Information Technologies.* 29, 7813-7813. Doi: https://doi.org/10.1007/s10639-023-12112-w

Shen, K., Cheng, Y., & Lee, M. (2022). Exploring preschool teachers' connections of teaching and learning, and their self-efficacy of classroom management and pedagogical content knowledge. *Asia-Pacific Education Research, 32*(2), 263-273. https://doi.org/10.1007/s40299-022-00649-2

Sung, W., An, H., & Thomas, C. L. (2024). What predicts K-12 teachers' technology integration practices in U.S. public schools? The relationship between teachers' beliefs and support. *Journal of Online Learning Research, 10*(1), 49-74.

Trumbul, D. J. & Slack, M. J. (1991). Learning to ask, listen, and analyse: using structured interviewing assignments to develop reflection in preservice science teachers. *International Journal of Science Education, 13*(2), 129-142. https://doi.org/10.1080/0950069910130201.

Teo, T. & Chai, S. C. (2008). Confirmatory factor analysis of conception for teaching and learning questionnaire (CTLQ). The Asia-Pacific Education Researcher, 17(2), 215-224.

Teo, T. & Zhou, M. (2015). The influence of teachers' conceptions of teaching and learning on their technology acceptance. *Interactive Learning Environemnt, 25*(4), 513-527. https://doi.org/10.1080/10494820.2016.1143844

Igwebuike, T. B., Okandeji, C. O., & Ekwevugbem A. O. (2012). Teacher educaators' conception of teaching and learning in teacher education institutions. *International Journal of Research Studies in Education, 2*(2), 43-52.

Tsai, C. (2002). Nested epistemologies: Science teachers' beleifs of teaching, learning and science. *International Journal of Science Education, 28*(8), 771-783. Doi:10.1080/09500690110049132.

Tsai, S., Tsai, W., Chai, S., Sung, J, & Fung, C. (2004). Evaluation of computer-assisted multimedia instruction in interavenous injection. *International Journal of Nursing studies,* 41, 191-198.

U.S. Department of Education. (2024, January). *A call to action for closing the digital access, design, and use divides: 2024 National Educational Technology Plan.* U.S. Department of Education. Retrieved from https://tech.ed.gov/files/2024/01/NETP24.pdf

Zupanec, V., Pribicevic, T., Miljanovic, T., & Radulovic, B. (2017). Teacher attitudes toward computer-assisted instruction in science teaching. *Paper presented at the 9th International Conference on Education and New Learning Technologies (EDULEARN).* Barcelona, Spain. July, 3-5-2.17.