

Research Article

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The effectiveness of using digital scientific stations in teaching social studies to develop visual thinking and self-learning skills among seventh-grade students

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Abstract

Background/purpose. This study aimed to investigate the impact of employing digital learning stations in teaching social studies on the development of visual thinking and self-learning skills among seventh-grade students.

Materials/methods. A quasi-experimental design was used, involving a sample of 57 seventh-grade female students from Um Kulthum Mixed School under the Zarqa First Directorate. Participants were divided into an experimental group (29 students) and a control group (28 students), with the former taught using digital learning stations and the latter taught through traditional methods. The study employed a visual thinking test comprising 15 validated questions and a self-learning scale consisting of 34 validated items to measure the outcomes.

Results. Statistically significant differences were found between the groups, favoring the experimental group. The overall visual thinking test scores, as well as all its sub-skills, showed significant improvement, with an effect size of 44.4%. Similarly, significant differences were observed in the overall self-learning scale scores and all its domains, favoring the experimental group with an effect size of 32.1%.

Conclusion. The findings suggest that the use of digital learning stations positively enhances visual thinking and self-learning skills among seventh-grade students. It is recommended that history teachers adopt this teaching strategy and that educational supervisors organize training workshops to support teachers in effectively implementing digital learning stations in history instruction.



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1. Introduction

The employment of scientific stations is considered one of the modern teaching strategies designed by Winsin Jones (Jones, 2007). This strategy emphasizes learning as a central component of the educational process, enabling students to construct their knowledge by relying on their prior experiences and collaborating with peers through various educational activities. Students rotate between stations within a time frame set by the teacher, each station equipped with tools, devices, educational materials, and worksheets to engage in specific educational tasks as part of diverse educational activities (Hamida, 2021).

Digital learning stations stand out for their focus on utilizing various technological tools to deliver educational content. They represent a blended learning model that emphasizes the integration of contemporary technological tools in modern education while fostering direct interaction within the classroom. These tools include computers, networks, and internet portals. This form of learning organizes information, scenarios, and educational experiences for students using multimedia resources provided by modern technology or information technology. It creates an engaging learning environment that contributes to improving students' overall academic performance (Ibrahim, 2021).

Digital learning stations are characterized by their emphasis on utilizing various technological tools and integrating them into the educational delivery process. They are a form of blended learning that prioritizes the use of modern technological tools in teaching and promotes direct classroom interaction through contemporary information and communication technology tools, such as computers, networks, and internet portals. This type of learning organizes information and educational experiences for students using multimedia tools provided by modern technology, creating an attractive educational environment that enhances students' overall academic performance (Ibrahim, 2021).

Denise Jones, the designer of the scientific stations strategy, identifies four types of scientific stations that teachers can design based on the lesson objectives, available time, student numbers, and resources. According to Jones (2007), these station types include:

1. Practical Stations, which allow students to engage in experimental and hands-on activities.
2. Visual Stations, which provide materials targeting visual stimuli, such as images and diagrams.
3. Auditory Stations, which enable students to listen to recordings and participate in discussions.
4. Electronic Stations, which rely on displaying multimedia and presentations via computers.

The effective organization and implementation of digital learning stations require teachers to follow specific steps, including rotating through all stations, rotating through half the stations, and employing segmented teaching methods.

1.1. Problem Statement and Research Questions

The researchers observed an apparent weakness among students in engaging with and enjoying the learning of historical content. Additionally, challenges hinder their ability to understand, analyze, and interpret past and contemporary historical events, thereby limiting their capacity to anticipate the future. This issue negatively impacts their motivation to learn history. This weakness may be attributed to various factors, including issues related to students, teachers, teaching strategies, and curricula. Therefore, the researchers sought to adopt a modern and advanced teaching strategy that enhances students' understanding, analysis, and prediction of future events based on current historical events. This approach aims to foster attitudes that improve their historical learning. This aligns with the findings of Ubaidat and Tawalbeh (2014), who emphasized that despite repeated efforts to develop and energize the study of history by incorporating modern teaching strategies to make it more engaging, students still show a lack of interest in studying it.

Based on the above, the researchers considered employing a teaching method that appeals to the interests of students, who are described as a predominantly digital generation that frequently uses digital tools in their lives. Thus, the idea of employing digital learning stations emerged, which are expected to contribute to the development of visual thinking and impart self-learning skills to students. This aligns with Tawalbeh (2017), who noted that one of the prominent features of the early 21st century is the emergence of engaging and attractive global technological services and applications that captivate users. Therefore, this study responds to modern teaching trends that focus on developing students' visual thinking and self-learning skills, aiming to uncover the impact of employing digital learning stations during social studies instruction on enhancing visual thinking and self-learning skills among seventh-grade students (Alarabi et al., 2022).

Specifically, the current study seeks to answer the following questions:

1. Are there statistically significant differences at the significance level ($\alpha \leq 0.05$) between the mean scores of the control group and the experimental group on the visual thinking test attributed to the teaching method (utilizing digital learning stations, self-learning skills, and traditional methods)?
2. Are there statistically significant differences at the significance level ($\alpha \leq 0.05$) between the mean scores of the control group and the experimental group on the scale for developing visual thinking and self-learning skills attributed to the teaching method (utilizing digital learning stations, self-learning skills, and traditional methods)?

1.2. Study Significance

This study is expected to shed light on one of the important teaching strategies aimed at improving students' achievement levels in social studies. By focusing on digital learning stations, the study contributes to the growing body of Arabic research on innovative instructional methods, particularly those involving the integration of technology in education.

Moreover, the findings of this research may draw the attention of curriculum developers in Jordan to the significance of incorporating digital learning stations and fostering self-learning skills within social studies curricula. This is especially relevant for textbooks dealing with history and national education, where such integration could enhance student engagement and foster a deeper understanding of the content.

The results of this study may benefit history and national education teachers by providing valuable insights into the practical application of digital learning stations and the development of self-learning skills within their instructional practices. In addition, the findings may encourage educational supervisors to organize training workshops that equip teachers with the necessary skills and strategies to incorporate digital learning stations into the teaching of social studies, ultimately enhancing the quality of instruction and student engagement.

1.3. Study Boundaries and Limitations

This study was confined to specific subject boundaries, focusing on one unit from the seventh-grade social studies textbook—Unit 4, titled "Civilizations of the Levant"—to explore the impact of using digital learning stations in enhancing visual thinking and self-learning skills among seventh-grade students. In terms of temporal boundaries, the study was conducted during the first semester of the 2024/2025 academic year. Spatially, the study was conducted at Um Kulthum Mixed School, which falls under the jurisdiction of the Zarqa First Directorate. Regarding human boundaries, the study was limited to seventh-grade female students at the same school.

As for the study's limitations, the findings are influenced by the specific conditions under which the sample was selected, including its size and the tools used in the research. Moreover, the results

depend on the methods applied during implementation and the accuracy of participants' responses. Therefore, the generalizability of the results remains constrained by the validity and reliability of the research tools and procedures.

1.4. Study Terms and Operational Definitions

Digital Learning Stations are defined as a teaching strategy in which small groups of students rotate through a series of learning centers or stations. This approach enables teachers, even with limited resources, to design compelling and differentiated learning experiences that address students' varying needs, interests, and learning styles (Jones, 2007, p. 102). Operationally, digital learning stations in this study refer to a strategy involving a set of teacher-designed digital activities—exploratory, enrichment, and electronic—implemented with seventh-grade students. These activities are conducted within small groups using internet resources to achieve specific educational objectives within set timeframes.

Social Studies are broadly defined as the study of individuals, communities, systems, and their interactions across time and space. This field prepares students for civic engagement at the local, national, and global levels by encouraging inquiry into human experiences, collecting and analyzing credible evidence, and considering multiple perspectives (Spring, 2023, p. 23). Operationally, social studies in this study refer to the integrated fields taught in Jordanian schools, including history, national education, civics, and geography, as part of the country's official curriculum.

Visual Thinking is defined as the mental process through which individuals reorganize visual experiences to solve problems. It involves perceiving the relationships between elements within a problem, including connections between premises and conclusions, causes and effects, general and specific concepts, and known and unknown information (Cai, 2018, p. 221). Operationally, visual thinking in this study refers to the student's ability to visually distinguish between diagrams and shapes used in the training program, recognize the relationships among their elements, and analyze and interpret these relationships to derive new meanings. This was assessed using the Visual Thinking Skills Test, which includes skills such as visual reading, visual discrimination, relationship perception, information interpretation, and meaning inference.

Self-learning skills are defined as the ability to acquire information and knowledge, and apply them effectively independently. These skills complement formal education, although they cannot replace it. Key components of self-learning include time management, recording and tracking, technical proficiency, internet and programming skills, and writing abilities (Todrovic, 2022, p. 50). Operationally, self-learning skills in this research are viewed as an intentional procedural process where students independently gain knowledge, concepts, principles, attitudes, and values using technological applications, programmed texts, and various instructional tools. The extent of these skills was measured by the scores obtained by seventh-grade students on the Self-Learning Skills Scale, which was developed specifically for this study.

2. Literature Review

Several researchers have explored the Digital Science Stations Strategy, recognizing its effectiveness in enhancing student engagement and motivation. Lonka (2015) identified it as one of the strategies that create an enjoyable, dynamic, and interactive learning environment, fostering student involvement and increasing their motivation to learn. Boschen (2018) emphasized that digital science stations aim to promote active student participation in all activities by allowing them to navigate through different stations. Similarly, Marvin (2007) highlighted its impact on addressing students' weaknesses and providing opportunities for them to engage actively in the learning process. Additionally, Ocak (2010) found that implementing learning stations has a positive influence on academic achievement and knowledge retention. Furthermore, Chamber (2013) underscored the

role of digital science stations in enhancing students' academic performance (Alneyadi & Wardat, 2024).

Due to the importance of thinking in all its forms, several studies, such as Siraj's (2019) study, have highlighted the significance of employing scientific stations and their role in teaching social studies, as well as in developing students' visual thinking and enhancing various skills across different subjects. These stations cultivate historical understanding, aid students in successful learning that facilitates the comprehension of historical and social material, and help simplify and clarify many challenging concepts present in history, such as the concepts of civilization and conflict. They also assist in understanding complex terms and meanings.

Salmi (2020) pointed out that the key skills of visual thinking include visual reading, which refers to the ability to identify the dimensions and nature of a displayed shape or image; visual discrimination, which is the ability to recognize and differentiate the displayed shape or image from others; perceiving relationships, meaning the ability to see cause-and-effect relationships among the elements or phenomena represented in a shape or diagram; interpreting information, which refers to the ability to explain the meanings of words, symbols, and signs in shapes and connect relationships between them; analyzing information, defined as the learner's ability to focus on detailed aspects while considering both general and specific data; and finally, inferring meaning, which refers to the ability to draw new meanings and reach scientific concepts and principles from the displayed shape or image (Tashtoush et al., 2023).

The objectives of the visual thinking strategy can be summarized as enhancing technical skills among students through diverse cultures in various times and places to build confidence in constructing meaning, improving observation skills, fostering active participation by asking unlimited questions and receiving supportive responses from the teacher, stimulating interaction through collaborative problem-solving in group work, and developing communication skills such as expression, listening to perspectives, managing discussions, and acquiring the ability to view a subject holistically and then break it down into components. Additionally, it aims to cultivate motivation and curiosity among students to seek knowledge (Yenawine, 2013).

One of the learning patterns that modern approaches aim to develop in students is self-learning, which is fundamentally based on providing students with sufficient opportunities to take responsibility for their learning, make decisions, increase interaction and collaboration with peers, conduct self-assessment, and monitor their progress. This necessitates the use of diverse thinking strategies, leading to an increase in intrinsic motivation, which in turn generates persistence and active participation in learning. Therefore, intrinsic motivation can be considered one of the essential pillars of self-learning (Singh, 2019).

Al-Suraie (2023) suggests that self-learning is an approach encompassing all modern educational activities and methods, enabling students to acquire lifelong learning skills. It emphasizes teaching students how to learn, fostering their independence in problem-solving, decision-making, and cultivating a love for learning. This type of learning relies on students' self-driven activities and their desire to acquire information based on their capabilities and potential. Students independently determine the suitable methods to achieve their learning goals, evaluate their progress, and continuously adapt to meet the demands of contemporary life. Unlike traditional learning methods, self-learning accommodates all learners at all levels (AlAli & Wardat, 2024).

The researchers believe that the nature of the social studies subject, as an essential discipline closely related to students' needs, interests, and future, necessitates modern strategies that address these aspects, particularly in this digital age. Among these strategies is the use of digital learning stations, which play a significant role in enhancing students' thinking and learning.

After reviewing previous studies that examined the effectiveness of employing digital learning stations in teaching social studies to develop visual thinking and self-learning skills among seventh-grade students, the researchers found a scarcity of studies addressing the impact of digital learning stations on these skills. The previous studies are presented chronologically, from the earliest to the most recent, as follows:

Eid (2020) conducted a study aimed at investigating the effectiveness of the educational stations strategy in teaching science to develop visual thinking and enhance the enjoyment of learning among primary-stage students in Tanta. The quasi-experimental method was employed by dividing the sample into two groups: an experimental group and a control group. The study tools included a teacher's guide for teaching a selected unit based on the educational stations strategy, worksheets, a visual thinking test, and a learning enjoyment scale. The sample consisted of 80 fourth-grade students, divided into 40 students in the experimental group and 40 in the control group. The study results revealed a significant impact of the strategy on developing visual thinking and learning enjoyment. Statistically significant differences were found between the mean scores of the experimental and control groups in the post-application of the learning enjoyment scale as a whole, its dimensions, and the visual thinking test as a whole and its dimensions, favoring the experimental group. Moreover, a statistically significant correlation was observed between the experimental group's post-application scores on the visual thinking test and the learning enjoyment scale.

Hamida (2021) conducted a study aimed at examining the effectiveness of the digital learning stations strategy in developing geometric sense skills and habits of mind among first-grade female students in preparatory schools in Egypt. The study sample consisted of 67 students from Taftesh Kafr Saad Preparatory School, with 35 students in the experimental group and 32 in the control group. The tools used included a questionnaire on geometric sense skills that should be developed in preparatory school students, a geometric sense skills test, a habits of mind scale, a teacher's guide, and a student activity notebook. The study results indicated the effectiveness of the digital learning stations strategy in enhancing geometric sense skills and habits of mind. Statistically significant differences were observed between the mean scores of the experimental group students on the pre-test and post-test of the geometric sense skills test, favoring the post-test results. Additionally, significant differences were found between the mean scores of the experimental and control groups in the post-test of the geometric sense skills test, favoring the experimental group. Furthermore, significant differences were noted between the pre-test and post-test mean scores of the experimental group in the habits of mind scale, favoring the post-test, as well as between the post-test mean scores of the experimental and control groups, favoring the experimental group.

Ibrahim (2021) aimed to explore the effectiveness of the digital learning stations strategy in developing reflective writing skills and digital competence among first-year general secondary school students. To achieve this goal, a reflective writing skills test and a digital performance observation checklist were developed and applied to a sample of 50 first-year general secondary students from schools in El-Kharga, New Valley. The study results revealed the superiority of the experimental group, which was exposed to the independent variable. Statistically significant differences were observed between the pre-test and post-test scores of the digital performance observation checklist, favoring the post-test. This demonstrated the effectiveness of the strategy in developing reflective writing skills and digital competence among first-year students in general secondary schools.

El-Sharkawy (2023) conducted a study to examine the effectiveness of digital learning stations in developing productive thinking among primary school students. A teacher's guide and worksheets were prepared in accordance with the digital learning stations strategy, along with a productive thinking test. The experimental method, employing a pre-test and post-test design, was used, involving two groups: experimental and control. The study sample consisted of 60 students from Al-Najah Primary School in Al-Batanun, Shebin El-Kom Educational Administration, Menoufia

Governorate. The students were divided into two groups: the experimental group, comprising 30 students taught using digital learning stations, and the control group, comprising 30 students taught using traditional methods. The results demonstrated the effectiveness of the digital learning stations in developing productive thinking among primary school students.

The current study shares similarities with previous studies in the methodology employed to achieve its objectives, which is the quasi-experimental approach. However, it distinguishes itself from prior research by aiming to examine the effectiveness of utilizing digital learning stations in teaching social studies, with the goal of developing visual thinking and self-learning skills among seventh-grade students. Based on this, the study was conducted to investigate the effectiveness of employing digital learning stations during social studies instruction to enhance visual thinking and self-learning skills among seventh-grade students.

3. Methodology

This chapter describes the methods and procedures used in the study. It includes a definition of the study tools used for data collection, the study methodology, population, sample selection and distribution, a description of the study design and its variables, the tools employed, their construction and application, as well as the verification of their validity and reliability. Additionally, it outlines the statistical methods used for data analysis and result extraction. In line with the nature of the study, the quasi-experimental approach was adopted (used to examine the relationship between two variables in their natural context without controlling for the variables). This method was used to measure the impact of employing digital learning stations during history instruction on developing visual thinking and self-learning skills among students. The study design consisted of an experimental group and a control group, designed to address the research questions.

Participants

The participants consisted of 57 seventh-grade female students during the 2024/2025 academic year at Um Kulthum Mixed School. The school was intentionally selected due to the collaboration and readiness of the social studies teacher to assist in implementing the study procedures. A simple random sampling method was used, dividing the participants into two groups:

- Control Group: Comprised of 28 students who studied Unit 4, Civilizations of the Levant, from the seventh-grade social studies textbook using traditional methods, without any intervention.
- Experimental Group: Comprised of 29 students who studied the same unit using the digital learning stations strategy.

Study Material: Teacher's Guide

To prepare the teacher's instructional guide, relevant theoretical literature and prior studies related to the social studies textbook and its teaching methods were thoroughly reviewed. Unit 4 from the seventh-grade social studies textbook, titled Civilizations of the Levant, was selected as the focus for developing the guide. The process involved several key steps: providing clear instructions on how to implement digital learning stations in teaching, explaining the teaching mechanism based on this strategy, and proposing a timeline for delivering the unit. Additionally, a comprehensive teaching plan was designed for Unit 4, which was implemented over eight 45-minute lessons. This plan outlined the general learning outcomes and proposed educational activities, serving as the foundation for the initial version of the instructional guide.

Validity

To ensure the validity of the guide for teaching Civilizations of the Levant, it was reviewed by 10 specialists in the field of education, including experts in social studies curricula, teaching methods, history, and educational supervision. Their feedback was sought regarding the guide's suitability for

students, content validity, feasibility, linguistic accuracy, and alignment with the required skills. Based on the reviewers' comments, the necessary revisions and adjustments were made to finalize the guide.

Tools

To achieve the study's objectives, two tools were developed: a test to measure visual thinking levels in both the pre-test and post-test phases, and a scale to assess self-learning levels among the students in the same phases. Below is a description of the study tools:

First: Visual Thinking Test

The researchers followed several steps to develop the visual thinking test:

1. Defining the Objective: The test aimed to measure visual thinking skills among the study sample.
2. Reviewing Literature: The researchers referred to educational literature and previous studies on visual thinking.
3. Identifying Visual Thinking Skills: The key skills identified were visual synthesis, attention to detail, and pattern recognition.
4. Selecting Test Questions: The questions were designed to align with visual thinking skills, relying primarily on visual images with corresponding questions.
5. Linking to the Curriculum: Questions were derived from the content of Unit 4: Civilizations of the Levant for seventh-grade students, targeting visual thinking skills identified in prior studies (visual synthesis, attention to detail, and pattern recognition).
6. Drafting the Initial Version: The initial version of the test included 15 multiple-choice questions. Each question was assigned a score based on its nature and the model answer.

Content Validity of the Visual Thinking Test

The visual thinking test was reviewed by 10 experts specializing in curricula, teaching methods, history, and educational supervision, as well as faculty members from Jordanian universities. These reviewers were asked to evaluate the clarity of the questions, their relevance to the test objectives, and the appropriateness of the content for the target age group. They also provided feedback on the phrasing, scientific and linguistic accuracy, and the alignment of the questions with the subject matter of the unit and the students' level of understanding.

Based on the reviewers' feedback, linguistic adjustments were made to some items, and certain answer choices were modified. The final version of the test consisted of 15 items distributed across the identified visual thinking skills. The majority of the items achieved an agreement rate of 80% or higher among the reviewers.

Table 1. Number of Items for Each Skill in the Visual Thinking Test

Skill	Question Number	Score	Relative Weight (%)
Visual Synthesis	1	2	8%
	4	3	12%
	6	1	4%
	7	2	8%
	13	1	4%

Skill	Question Number	Score	Relative Weight (%)
Total Questions	5	9	36%
Attention to Detail	3	1	4%
	5	1	4%
	10	1	4%
	12	1	4%
	15	1	4%
Total Questions	5	5	20%
Pattern Recognition	2	2	8%
	8	4	16%
	9	1	4%
	11	3	12%
	14	1	4%
Total Questions	5	11	44%
Overall Total	15	25	100%

Test Scoring Method

A scoring key was developed to evaluate student performance, with a maximum score of 25 for the visual thinking test. To ensure the construct validity of the test, internal consistency was examined by administering the test to a pilot sample of 25 seventh-grade students who were not part of the main study sample. The validity of the test was further confirmed through the calculation of difficulty and discrimination indices for each test item, demonstrating the test's ability to effectively measure visual thinking skills.

Table 2. Difficulty and Discrimination Indices for the Visual Thinking Test Items

Item	Difficulty Index	Discrimination Index
1	0.60	0.33
2	0.64	0.58
3	0.72	0.67
4	0.40	0.50
5	0.44	0.67
6	0.52	0.50
7	0.56	0.42
8	0.36	0.67
9	0.72	0.50
10	0.68	0.33
11	0.60	0.58

Item	Difficulty Index	Discrimination Index
12	0.56	0.67
13	0.32	0.50
14	0.68	0.58
15	0.56	0.42

The analysis of the visual thinking test items revealed that the difficulty indices ranged between 0.32 and 0.72, which fall within the acceptable range. According to Ouda (2014), a test item is considered good and acceptable if its difficulty index lies between 0.20 and 0.80; therefore, no items were eliminated based on this criterion. Similarly, the discrimination indices for the test items ranged from 0.33 to 0.67, which are also within the acceptable range. As stated by Ouda (2014), an item is deemed acceptable if its discrimination index exceeds 0.25. Consequently, all items were retained, confirming the appropriateness of the test items in measuring the intended construct.

Construct Validity

The construct validity of the visual thinking test was verified by administering it to the previously mentioned pilot sample. Correlation coefficients were calculated for each item with the overall test and the specific dimension to which it belongs, as well as with the test as a whole.

Table 3. Correlation Coefficients of Visual Thinking Skills Test Questions with the Dimension and the Overall Test

Visual Synthesis			Attention to Detail			Pattern Recognition		
Item	With Skill	With Test	Item	With Skill	With Test	Item	With Skill	With Test
1	**0.66	**0.58	3	**0.75	**0.66	2	**0.59	*0.36
4	**0.55	**0.81	5	**0.76	**0.66	8	**0.58	**0.47
6	**0.49	**0.83	10	**0.55	**0.66	9	**0.46	**0.55
7	**0.70	**0.71	12	**0.47	**0.66	11	**0.67	**0.79
13	**0.69	**0.66	15	*0.31	**0.66	14	**0.65	**0.78
With Skill		**0.82	With Skill		**0.78	With Skill		**0.77

** Statistically significant at the 0.01 level ($\alpha = 0.01$)

* Statistically significant at the 0.05 level ($\alpha = 0.05$)

The correlation coefficients ranged between 0.31 and 0.83, with a correlation coefficient threshold of 0.20 adopted as the criterion for item acceptance, as indicated by Ouda (2010).

Time Required to Administer the Visual Thinking Test

The time required for each student in the pilot sample to complete the test was recorded. The average test time was calculated by summing the time taken by all students and dividing it by the total number of students. The average test time was determined to be 40 minutes. An additional five minutes were allocated for reading instructions and writing personal details, making the total time 45 minutes.

Reliability of the Visual Thinking Test

The reliability of the visual thinking test was verified by administering the test to the same pilot sample and re-administering it two weeks later. Correlation coefficients between the two administrations were calculated. Additionally, the internal consistency reliability was assessed using Cronbach's alpha coefficient.

Table 4. Correlation Coefficients Between Test-Retest Administrations and Cronbach's Alpha Reliability Coefficients for the Visual Thinking Test

Dimension	Correlation Coefficient (Test-Retest)	Cronbach's Alpha Coefficient
Visual Synthesis	0.76	0.82
Attention to Detail	0.79	0.88
Pattern Recognition	0.82	0.86
Overall Test	0.83	0.89

The internal consistency reliability using Cronbach's alpha ranged between 0.82 and 0.86 for the sub-skills, and 0.89 for the overall test. The test-retest reliability coefficients ranged between 0.76 and 0.82 for the sub-skills, and 0.83 for the overall tool. All values exceeded 0.70, indicating that the tool is reliable.

Second: Self-Learning Scale

The development of the self-learning scale followed a structured process. First, the objectives were defined, with the primary aim being to measure the level of self-learning among seventh-grade female students in history. Next, relevant educational literature and previous studies related to self-learning were reviewed to inform the construction of the scale. Based on this foundation, an initial draft was created, consisting of 34 items distributed across four key domains: self-learning skills, guidance and control, skills for using learning resources, and self-assessment skills. To evaluate student responses effectively, a three-point Likert scale (High, Medium, Low) was employed for each item, allowing for a suitable assessment of self-learning levels.

Validity of the Self-Learning Scale

To ensure the validity of the self-learning scale, it was presented to 10 experts from Jordanian university faculty members specializing in curricula, teaching methods, educational psychology, educational and psychological counseling, and measurement and evaluation. The experts evaluated the clarity, accuracy, and appropriateness of the items for measuring their intended objectives. Suggestions for modifications, deletions, additions, or rewording were incorporated. Items that achieved at least 80% agreement among the reviewers were retained. After considering the feedback, the final scale consisted of 34 items distributed across four domains as follows:

- Domain 1: Self-learning skills (Items 1–9).
- Domain 2: Guidance and control (Items 10–18).
- Domain 3: Skills for using learning resources (Items 19–26).
- Domain 4: Self-assessment skills (Items 27–34).

Construct Validity of the Self-Learning Scale

The internal consistency of the scale was verified by calculating the correlation coefficients between each item and its respective domain, as well as the overall score. This was done using a pilot sample of 25 students outside the main study sample.

Table 5. Correlation Coefficients of Items with Their Domain and the Overall Score for the Self-Learning Scale

Item	Correlation with Domain	Correlation with Overall Score	Item	Correlation with Domain	Correlation with Overall Score
Domain 1: Self-Learning Skills (r = 0.704)**					
1	0.485**	0.446**	6	0.729**	0.535**
2	0.471**	0.500**	7	0.466**	0.609**
3	0.402*	0.498**	8	0.633**	0.595**
4	0.738**	0.375*	9	0.465**	0.579**
5	0.750**	0.448*			
Domain 2: Guidance and Control (r = 0.889)**					
10	0.561**	0.645**	15	0.635**	0.507**
11	0.551**	0.542**	16	0.667**	0.602**
12	0.468**	0.368*	17	0.621**	0.452**
13	0.376*	0.389*	18	0.453**	0.370*
14	0.735**	0.491**			
Domain 3: Skills for Using Learning Resources (r = 0.671)**					
19	0.528**	0.686**	23	0.723**	0.639**
20	0.874**	0.777**	24	0.907**	0.599**
21	0.809**	0.736**	25	0.718**	0.527**
22	0.795**	0.638**	26	0.835**	0.557**
Domain 4: Self-Assessment Skills (r = 0.804)**					
27	0.859**	0.721**	31	0.769**	0.707**
28	0.836**	0.512**	32	0.804**	0.425*
29	0.875**	0.635**	33	0.891**	0.550**
30	0.759**	0.378*	34	0.638**	0.432**

** Statistically significant at the 0.01 level ($\alpha = 0.01$). * Statistically significant at the 0.05 level ($\alpha = 0.05$).

The correlation coefficients ranged between 0.368 and 0.889, while the correlation coefficients between each domain and the overall score of the scale ranged from 0.671 to 0.889. A correlation coefficient threshold of 0.20 was adopted as the criterion for item acceptance.

3. Scale Reliability

The reliability of the self-learning scale was verified by administering it to the same pilot sample and re-administering it two weeks later. Correlation coefficients between the two administrations

were calculated. Additionally, internal consistency reliability was assessed using Cronbach's alpha coefficient.

Table 6. Correlation Coefficients for Test-Retest Reliability and Cronbach's Alpha Reliability Coefficients for the Self-Learning Scale

Domain	Test-Retest Reliability Coefficient	Cronbach's Alpha Coefficient
Self-Learning Skills	0.84	0.88
Guidance and Control	0.81	0.83
Skills for Using Learning Resources	0.78	0.86
Self-Assessment Skills	0.79	0.82
Overall Scale	0.85	0.91

The internal consistency reliability coefficients using Cronbach's alpha ranged between 0.82 and 0.88 for the sub-domains and 0.91 for the overall scale. The test-retest reliability coefficients, calculated using Pearson's correlation, ranged between 0.78 and 0.84 for the sub-domains and 0.85 for the overall scale. All values exceed 0.70, indicating that the tool is reliable.

Scoring the Self-Learning Scale

The final version of the scale consists of 34 items, each with a three-point Likert scale reflecting the respondent's degree of agreement:

High: 3 points

Medium: 2 points

Low: 1 point

To evaluate the level of self-learning, the following criteria for mean scores were adopted:

Table 7. Evaluation Criteria for the Level of Self-Learning,

Mean Range	Level
1.00–1.66	Low Level
1.67–2.33	Medium Level
2.34–3.00	High Level

This scale was determined by dividing the maximum score (3) into three equal categories within the range of 1–3, using the following formula:

$$\text{Range} = \frac{\text{Maximum Value} - \text{Minimum Value}}{\text{Number of Levels}} = \frac{3 - 1}{3} = 0.66$$

Group Equivalence: Visual Thinking Test

To verify the equivalence of groups, the means and standard deviations of the seventh-grade students' pre-test performance on the visual thinking test were calculated for both the experimental and control groups. To identify statistical differences between the means, a t-test was conducted.

Table 7. Results of the T-Test on Pre-Test Scores for the Visual Thinking Test by Group

Skill	Group	Mean	Standard Deviation	T	Degrees of Freedom	Significance Level
Visual Synthesis	Experimental	3.14	0.92	0.220	55	0.826
	Control	3.07	1.33			
Attention to Detail	Experimental	1.79	0.73	0.835	55	0.631
	Control	1.89	0.83			
Pattern Recognition	Experimental	4.41	1.21	0.108	55	0.915
	Control	4.46	2.20			
Overall Test	Experimental	9.34	1.70	0.141	55	0.889
	Control	9.43	2.70			

The results in Table 7 indicate no statistically significant differences at the significance level ($\alpha = 0.05$) between the pre-test means of the experimental and control groups for the overall visual thinking test and for each of the three individual skills. The T-value for the overall test was 0.141, with a significance level of 0.889, which is not statistically significant at $\alpha = 0.05$.

Group Equivalence: Self-Learning Scale

To verify the equivalence of the groups, the means and standard deviations of seventh-grade students' pre-test scores on the self-learning scale were calculated for both the experimental and control groups. To determine statistical differences between the means, an Independent Samples t-test was conducted.

Table 8. Results of the Independent Samples T-Test for Pre-Test Estimates of Self-Learning Levels by Group (Experimental, Control)

Domain	Group	Mean	Standard Deviation	T	Degrees of Freedom	Significance Level
Self-Learning Skills	Experimental	1.16	0.18	0.131	55	0.896
	Control	1.15	0.39			
Guidance and Control	Experimental	1.35	0.24	0.342	55	0.734
	Control	1.33	0.15			
Use of Learning Resources	Experimental	1.16	0.15	0.513	55	0.610
	Control	1.17	0.12			
Self-Assessment Skills	Experimental	1.11	0.14	1.584	55	0.119
	Control	1.06	0.07			
Overall Self-Learning Scale	Experimental	1.20	0.09	0.511	55	0.612
	Control	1.18	0.12			

The results presented in Table 8 show that there were no statistically significant differences at the significance level of ($\alpha = 0.05$) between the pre-test mean scores of the experimental and control groups on the overall self-learning scale or any of its four domains. Specifically, the T-value for the overall self-learning scale was 0.511, with a significance level of 0.612, which is not statistically

significant. These findings indicate that the experimental and control groups were equivalent in terms of self-learning levels before the intervention.

The study included both independent and dependent variables. The independent variable was the teaching strategy, which had two categories: the use of digital learning stations and the traditional teaching method. The dependent variables were the levels of visual thinking and its associated skills, as well as the levels of self-learning and its various domains, all measured among seventh-grade female students.

Design

To achieve the study's objectives, a quasi-experimental design was used with two groups (experimental and control). Pre-tests (visual thinking test and self-learning scale) were administered to both groups. The experimental group was exposed to the intervention (digital learning stations), while the control group followed the traditional method. Post-tests were then administered to both groups.

Procedures

To address the study questions, the researchers followed these steps:

1. Conducted a comprehensive review of social studies curricula in Jordan, particularly the history sections.
2. Reviewed previous literature on using digital learning stations in history instruction.
3. Selected a unit from the seventh-grade social studies textbook titled *Civilizations of the Levant*, covering four lessons:
 - Ancient Civilizations of the Levant (Origins)
 - Ancient Civilizations of the Levant (Cultural Features and Achievements)
 - Civilizations of Ancient Kingdoms in Jordan
 - Ancient Civilizations of the Levant (Decline Phase)
4. Purposefully selected the school for the study, obtaining initial approval from the history teacher and school principal. Both expressed their readiness to cooperate.
5. Prepared a teacher's guide for teaching the unit *Civilizations of the Levant* using digital learning stations.
6. Designed a timeline for teaching the unit over eight sessions, with two sessions per lesson.
7. Secured a facilitation letter from Yarmouk University to the Zarqa First Directorate of Education.
8. Obtained a facilitation letter from the Zarqa First Directorate to the principal of Um Kulthum Mixed School for study implementation.
9. Trained the history teacher on using digital learning stations through the prepared guide, discussing the guide, and conducting a demonstration lesson.
10. Randomly assigned participants to experimental and control groups using simple random sampling.
11. Designed the visual thinking test and self-learning scale, ensuring their validity and reliability.
12. Administered pre-tests (visual thinking and self-learning) to both groups before the intervention.

13. Applied the experimental treatment, teaching the experimental group using digital learning stations while the control group followed the traditional method. The content was covered in eight sessions, with two sessions per week.

14. Conducted intensive and semi-daily follow-ups during the intervention to ensure adherence to the guide for the experimental group and traditional methods for the control group.

15. Administered post-tests (visual thinking and self-learning) to both groups.

16. Scored the study tools and ensured consistency in scoring.

17. Organized and tabulated the collected data according to the study design and conducted descriptive and inferential statistical analyses using SPSS.

18. Interpreted the results.

Statistical Analysis

The data were analyzed using a combination of descriptive and inferential statistical methods. Descriptive statistics included calculating means and standard deviations for students' scores on both the visual thinking test and the self-learning scale, covering pre- and post-test results. For inferential analysis, an Independent Samples t-test was used to confirm the equivalence of the experimental and control groups based on their pre-test scores. To examine the post-test outcomes, ANCOVA (Analysis of Covariance) was conducted for both dependent variables—the visual thinking test and the self-learning scale. Additionally, MANCOVA (Multivariate Analysis of Covariance) was performed to analyze the individual dimensions within the visual thinking test and the self-learning scale across the experimental and control groups.

4. Results

First: Results Related to the First Research Question

The first question stated: "Are there statistically significant differences at the significance level ($\alpha = 0.05$) between the mean scores of the control group and the experimental group on the visual thinking test attributed to the teaching method (digital learning stations vs. traditional method)?"

To answer this question, the first null hypothesis was tested, which states: There is no statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of the experimental group and the control group on the visual thinking test attributed to the teaching method (digital learning stations vs. traditional method).

To answer the first question and test the hypothesis, the means and standard deviations for the scores of the two study groups on the visual thinking test were calculated for both the pre-test and post-test based on the teaching method (digital learning stations and traditional method).

Table 9. Means and Standard Deviations for the Scores of the Control and Experimental Groups on the Visual Thinking Test in the Pre-Test and Post-Test According to the Teaching Method

Groups	Pre-test		Post-test	
	Mean	SD	Mean	SD
Experimental Group (Digital Learning Stations)	9.34	1.70	17.97	2.38
Control Group (Traditional Method)	9.43	2.70	12.86	3.37

Note: The total possible score is 25.

The data in Table 9 indicate apparent differences between the mean scores of the study participants on the visual thinking test in both the pre-test and post-test, based on the teaching method (digital learning stations vs. traditional method).

To determine whether these differences are statistically significant, a One-Way ANCOVA was conducted on the post-test scores for the overall visual thinking test, considering the teaching method (digital learning stations vs. traditional method) while controlling for the effect of the pre-test.

Table 10. One-Way ANCOVA for the Post-Test Scores of Study Participants on the Visual Thinking Test Based on Teaching Method (Digital Learning Stations vs. Traditional Method), Controlling for Pre-Test Scores

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-Value	Significance Level	Eta-Squared (η^2)
Pre-Test	2.814	1	2.814	0.328	0.569	0.006
Teaching Method	370.386	1	370.386	43.144	0.000	0.444
Error	463.580	54	8.585			
Total	14455.000	57				

The results in Table 1 indicate statistically significant differences at the significance level ($\alpha = 0.05$) in the scores of study participants on the visual thinking test based on the teaching method (digital learning stations vs. traditional method). The F-value was 43.144 with a significance level of 0.000, indicating a significant effect of the teaching method.

The effect size (Eta-Squared) was 0.444, suggesting a large effect of the teaching method, explaining 44.4% of the variance in the dependent variable (visual thinking skills test).

To identify the direction of the differences, the adjusted means and standard errors for each group were calculated.

Table 11. Adjusted Means and Standard Errors for the Visual Thinking Skills Test by Teaching Method

Teaching Method	Adjusted Mean	Standard Error
Digital Learning Stations	17.961	0.544
Traditional Method	12.861	0.554

The results in Table 11 indicate that the differences favored the experimental group, whose participants were taught using the digital learning stations method, compared to the control group taught using the traditional method. Based on the results of the ANCOVA, the digital learning stations method had a statistically significant effect in improving the performance of the experimental group in developing visual thinking skills.

Next, the means and standard deviations for the pre-test and post-test scores on individual visual thinking skills were calculated for each skill separately, based on the teaching method.

Table 12. Means and Standard Deviations for Pre-Test and Post-Test Scores on Individual Visual Thinking Skills

Skill	Group	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD
Visual Synthesis	Experimental	3.14	0.92	6.69	1.37
	Control	3.07	1.33	4.96	1.37
	Total	3.11	1.13	5.84	1.61
Attention to Detail	Experimental	1.79	0.73	3.48	0.99
	Control	1.89	0.83	2.46	1.29
	Total	1.84	0.77	2.98	1.25
Pattern Recognition	Experimental	4.41	1.21	7.79	1.40
	Control	4.46	2.20	5.43	1.93
	Total	4.44	1.75	6.63	2.05

The data in Table 12 shows apparent differences in the mean scores between the pre-test and post-test for the visual thinking skills. To examine the significance of these apparent differences, a multivariate one-way ANCOVA was conducted.

Table 13. Multivariate One-Way ANCOVA Results for the Effect of Group (Experimental, Control) on Visual Thinking Skills Test

Effect	Multivariate Test Type	Test Value	F Value	Hypothesis DF	Error DF	Significance Level	Effect Size (η^2)
Teaching Method	Hotelling's Trace	0.812	14.343	3.000	53.000	0.000	0.448

The results in Table 13 indicate a statistically significant effect of the teaching method on visual thinking skills (Hotelling's Trace = 0.812, $p = 0.000$). The effect size (η^2) suggests that the teaching method explains 44.8% of the variance in performance across the three visual thinking skills.

To further test the statistical significance of the differences in post-test performance for the three skills (visual synthesis, attention to detail, and pattern recognition) after controlling for pre-test scores, a one-way ANCOVA for individual skills was conducted (Subject Effect Test of Between).

Table 14. One-Way ANCOVA (Subject Effect Test of Between) for Statistical Significance of Differences in Post-Test Performance on Individual Visual Thinking Skills After Controlling for Pre-Test Scores by Teaching Method

Source of Variation	Skill	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Significance Level	Effect Size (η^2)
Covariate (Pre-Test)	Visual Synthesis	1.916	1	1.916	1.022	0.317	0.019
	Pattern Recognition	1.589	1	1.589	1.215	0.275	0.022
	Attention to Detail	2.586	1	2.586	0.912	0.344	0.017

Source of Variation	Skill	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Significance Level	Effect Size (η^2)
Teaching Method	Visual Synthesis	42.907	1	42.907	22.883	0.000	0.298
	Pattern Recognition	15.349	1	15.349	11.738	0.001	0.179
	Attention to Detail	79.214	1	79.214	27.952	0.000	0.341
Error	Visual Synthesis	101.256	54	1.875			
	Pattern Recognition	70.617	54	1.308			
	Attention to Detail	153.030	54	2.834			
Total	Visual Synthesis	2091.000	57	2091.000			
	Pattern Recognition	594.000	57	594.000			
	Attention to Detail	2742.000	57				
Corrected Total	Visual Synthesis	145.579	56				
	Pattern Recognition	86.982	56				
	Attention to Detail	235.263	56				

The results presented in Table 14 reveal statistically significant differences at the significance level of ($\alpha = 0.05$) between the teaching methods—digital learning stations versus the traditional method—across all measured skills. Specifically, for Visual Synthesis, the F-value was 22.883 with a p-value of 0.000, and an effect size (η^2) of 0.298. For Pattern Recognition, the F-value was 11.738 with a p-value of 0.001, and an effect size of 0.179. For Attention to Detail, the F-value reached 27.952 with a p-value of 0.000, and an effect size of 0.341. These effect sizes indicate that the teaching method accounted for a substantial portion of the variance in post-test performance—29.8% for Visual Synthesis, 17.9% for Pattern Recognition, and 34.1% for Attention to Detail. To identify which group benefited more significantly from the teaching method, adjusted means and standard errors for each skill were subsequently calculated.

Table 15. Adjusted Means and Standard Errors for the Post-Test of Visual Thinking Skills by Teaching Method

Skill	Teaching Method	Adjusted Mean	Standard Error
Visual Synthesis	Digital Learning Stations	6.695	0.254
	Traditional Method	4.959	0.259
Pattern Recognition	Digital Learning Stations	3.493	0.213
	Traditional Method	2.453	0.216
Attention to Detail	Digital Learning Stations	7.790	0.313
	Traditional Method	5.432	0.318

The results show significant differences between the performance of the experimental and control groups in visual synthesis, pattern recognition, and attention to detail, favoring the experimental group. According to the ANCOVA results, digital learning stations had a statistically significant impact on improving the experimental group's performance across all three visual thinking skills. The effect sizes for these skills ranged from 17.9% to 34.1%, indicating substantial influence.

Findings for the First Research Question

The results revealed statistically significant differences in the post-test scores of study participants on the visual thinking test, both overall and across all individual skills, based on the teaching method (digital learning stations vs. traditional method). These differences favored the experimental group taught using the digital learning stations method, with an overall effect size of 44.4%.

This result can be attributed to the structured, interactive, and engaging nature of digital learning stations, which facilitate learning by addressing students' needs, interests, and learning styles. The stations utilize a variety of activities such as reading, exploration, and technology-based tasks. Each station includes specific activities or skills with unique worksheets, enhancing student engagement, motivation, and academic achievement.

Digital learning stations also fostered students' analytical and predictive abilities in history, enabling them to interpret and analyze historical and social events more effectively. This method simplified complex concepts and made the subject more accessible and engaging, leveraging technology to enrich the educational experience.

These findings align with Eid (2020), which demonstrated the effectiveness of learning stations in teaching science, improving visual thinking and learning enjoyment for elementary students, and Sharqawi (2023), which highlighted the role of digital learning stations in fostering productive thinking in elementary school students. This aligns with Tawalbeh (2025) finding that social studies teachers can ignite students' passion and motivation, driving them to read more books for the purpose of knowledge enrichment and benefit, rather than limiting themselves to the content of school textbooks alone.

Findings for the Second Research Question

The second research question asked:

"Are there statistically significant differences at the significance level ($\alpha = 0.05$) between the mean scores of the experimental group and the control group on the self-learning scale attributed to the teaching method (digital learning stations vs. traditional method)?"

To address this question, the following null hypothesis was tested:

- *There is no statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of the experimental and control groups on the self-learning scale attributed to the teaching method (digital learning stations vs. traditional method).*

To answer this question, means and standard deviations for seventh-grade students' scores on the self-learning scale were calculated for both the pre-test and post-test based on the teaching method (digital learning stations vs. traditional method).

Table 16. Means and Standard Deviations for Study Participants' Scores on the Self-Learning Skills Scale in the Pre-Test and Post-Test by Group (Experimental, Control)

Group	Pre-Test	Post-Test
Teaching Method	Mean	SD
Digital Learning Stations	1.20	0.09
Traditional Method	1.18	0.12

The results in Table 16 indicate apparent differences in the mean scores of study participants on the self-learning scale between the pre-test and post-test, based on the teaching method (digital learning stations vs. traditional method).

To determine whether these differences are statistically significant, a One-Way ANCOVA was conducted on the post-test scores for the overall self-learning scale, considering the teaching method while controlling for the effect of the pre-test.

Table 17. One-Way ANCOVA for the Post-Test Scores of Study Participants on the Self-Learning Scale Based on Teaching Method (Digital Learning Stations vs. Traditional Method), Controlling for Pre-Test Scores

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Significance Level	Eta-Squared (η^2)
Pre-Test	0.018	1	0.018	0.082	0.776	0.002
Teaching Method	5.534	1	5.534	25.487	0.000	0.321
Error	11.724	54	0.217			
Total	303.091	57				

The results indicate statistically significant differences at the significance level ($\alpha = 0.05$) in the post-test scores on the self-learning scale based on the teaching method (digital learning stations vs. traditional method). The F-value was 25.487, with a significance level of 0.000, confirming a statistically significant effect of the teaching method.

The effect size (η^2) was 0.321, indicating that the teaching method accounted for 32.1% of the variance in the dependent variable (self-learning scale).

To determine which group benefited more, the adjusted means and standard errors for the groups were calculated.

Table 18. Adjusted Means and Standard Errors for the Self-Learning Scale by Teaching Method

Teaching Method	Adjusted Mean	Standard Error
Digital Learning Stations	2.546	0.087
Traditional Method	1.921	0.088

The results indicate that the differences were in favor of the experimental group, whose members were taught using the digital learning stations method, compared to the control group taught using the traditional method. According to the results of the ANCOVA analysis, digital learning stations had a statistically significant effect on improving the experimental group's performance in developing self-learning skills.

Next, the means and standard deviations for the pre-test and post-test scores on individual domains of the self-learning scale were calculated for each domain separately, based on the teaching method.

Table 19. Means and Standard Deviations for Pre-Test and Post-Test Scores on Individual Domains of the Self-Learning Scale

Domain	Group	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD
Self-Learning Skills	Experimental	1.16	0.18	2.48	0.43
	Control	1.15	0.39	1.89	0.76
	Total	1.16	0.30	2.19	0.67
Guidance and Control	Experimental	1.35	0.24	2.62	0.42
	Control	1.33	0.15	1.88	0.78
	Total	1.34	0.20	2.25	0.72
Using Learning Resources	Experimental	1.16	0.15	2.58	0.46
	Control	1.17	0.12	1.97	0.84
	Total	1.16	0.13	2.28	0.74
Self-Assessment Skills	Experimental	1.11	0.14	2.51	0.56
	Control	1.06	0.07	1.94	0.83
	Total	1.09	0.12	2.23	0.75

The results reveal notable differences between the pre-test and post-test mean scores across all domains of the self-learning scale, influenced by the teaching method—digital learning stations versus the traditional approach. In the post-test, the experimental group demonstrated superior performance compared to the control group in several areas: self-learning skills (mean = 2.48 vs. 1.89), guidance and control (2.62 vs. 1.88), using learning resources (2.58 vs. 1.97), and self-assessment skills (2.51 vs. 1.94). These findings clearly indicate that the use of digital learning stations significantly improved the experimental group's performance across all measured domains of self-learning.

Table 20. Multivariate One-Way ANCOVA Results for the Effect of Group (Experimental, Control) on the Self-Learning Scale

Effect	Multivariate Test Type	Test Value	F Value	Hypothesis DF	Error DF	Significance Level	Effect Size (η^2)
Teaching Method	Hotelling's Trace	0.545	7.083	4.000	52.000	0.000	0.353

The results indicate a statistically significant effect of the teaching method (digital learning stations vs. traditional method) on the domains of the self-learning scale. The F-value was 7.083, with a significance level of 0.000, confirming a significant impact of the teaching method.

The effect size (η^2) was 0.353, indicating that the teaching method explained 35.3% of the variance in performance across the four domains of self-learning skills.

To further examine the statistical significance of differences in the post-test performance across individual domains (self-learning skills, guidance and control, using learning resources, and self-assessment skills) after controlling for pre-test scores, a Subject Effect Test of Between was conducted.

Table 21. One-Way ANCOVA (Subject Effect Test of Between) for Post-Test Performance on Individual Domains of the Self-Learning Scale

Source of Variation	Domain	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Significance Level	Effect Size (η^2)
Covariate (Pre-Test)	Self-Learning Skills	0.150	1	0.150	0.394	0.533	0.007
	Guidance and Control	0.080	1	0.080	0.204	0.654	0.004
	Using Learning Resources	1.118	1	1.118	2.529	0.118	0.045
	Self-Assessment Skills	0.490	1	0.490	0.988	0.325	0.018
Teaching Method	Self-Learning Skills	4.899	1	4.899	12.917	0.001	0.193
	Guidance and Control	7.780	1	7.780	19.814	0.000	0.268
	Using Learning Resources	5.655	1	5.655	12.788	0.001	0.191
	Self-Assessment Skills	5.038	1	5.038	10.157	0.002	0.158
Error	Self-Learning Skills	20.482	54	0.379			
	Guidance and Control	21.202	54	0.393			
	Using Learning Resources	23.882	54	0.442			
	Self-Assessment Skills	26.786	54	0.496			

It is evident from Table 21 that there are statistically significant differences at the significance level ($\alpha = 0.05$) based on the effect of the teaching method (digital learning stations vs. traditional method) across all domains of the self-learning scale.

To determine which group these differences favor, the adjusted means and standard errors for the skills were calculated based on the teaching method.

Table 22. Adjusted Means and Standard Errors for the Post-Test of the Self-Learning Scale by Teaching Method

Domain	Teaching Method	Adjusted Mean	Standard Error
Self-Learning Skills	Digital Learning Stations	2.478	0.114
	Traditional Method	1.892	0.116
Guidance and Control	Digital Learning Stations	2.618	0.116
	Traditional Method	1.878	0.118
Using Learning Resources	Digital Learning Stations	2.588	0.124
	Traditional Method	1.957	0.126
Self-Assessment Skills	Digital Learning Stations	2.532	0.132
	Traditional Method	1.924	0.135

It is evident from Table 22 that there are differences between the experimental and control groups in the self-learning scale, guidance and control skills, and using learning resources, favoring the experimental group. According to the results of the ANCOVA, the digital learning stations had a statistically significant effect on improving the performance of the experimental group in the self-learning scale, guidance and control skills, using learning resources, and self-assessment skills, with effect sizes ranging from 15.8% to 26.8%.

Findings Related to the Second Research Question

The results showed statistically significant differences in the scores of study participants on the self-learning scale, both overall and across all domains, based on the teaching method (digital learning stations vs. traditional method). These differences favored the experimental group taught using digital learning stations, with an effect size of 32.1%.

This result can be attributed to the fact that the digital learning stations strategy fosters intellectual approaches that enhance self-learning by activating a constructivist approach. This approach places the learner at the center of the educational process, encouraging exploratory practices that enable students to engage in experimentation using various scientific processes. It also promotes inquiry-based learning, allowing students to practice planning, execution, and evaluation to achieve new scientific concepts. These practices contributed to developing self-learning skills since the learners are responsible for tasks assigned at each station. They are continuously monitored by the teacher and cannot proceed to the next station without completing tasks at the current one. This process enhances their confidence, instills a sense of responsibility, and motivates them to prove their abilities through repeated attempts, ultimately boosting their self-learning level.

Moreover, the digital learning stations strategy helped break the monotony of classroom routines, providing students with the opportunity to move around the classroom and experience diverse practical and theoretical activities. This variety catered to their educational needs. Engaging

in discovery activities increased their self-confidence and ability to independently acquire and uncover information, thus enhancing their self-learning across all domains. The hands-on experiences and discovery-based learning through inquiry made the learning process meaningful, improving their understanding of the studied topics.

Observations during the implementation phase further confirmed that digital learning stations activated students' positive roles through hands-on activities. These activities provided direct sensory experiences using the digital components available at the stations, adding enjoyment, variety, and movement within the classroom. The stations offered a mix of practical and theoretical experiences, including reading, exploration, experimentation, listening, research, and more. Students were given access to original scientific resources such as smart encyclopedias, dictionaries, atlases, digital manuscripts, documents, electronic journals, and original references. They were able to extract and classify information from these original sources. Working with such resources improved their self-learning skills by fostering independence in completing assignments and performing various tasks.

These findings align with those of Ibrahim (2021), which demonstrated the effectiveness of digital learning stations in developing reflective writing skills and digital competence among first-year secondary school students.

6. Conclusion

This study examined the effectiveness of digital learning stations in enhancing visual thinking skills and self-learning abilities among seventh-grade students in social studies. The findings demonstrated that digital learning stations had a significant positive impact on both visual thinking and self-learning skills. The experimental group, taught using digital learning stations, outperformed the control group, taught using traditional methods, in all measured aspects. Specifically, the teaching method accounted for 44.4% of the variance in visual thinking skills and 32.1% in self-learning skills, highlighting the strategy's effectiveness.

Digital learning stations proved to be an innovative approach that actively engaged students by integrating interactive, hands-on, and technology-enhanced activities into the learning process. This method broke the monotony of traditional teaching by providing diverse learning experiences that fostered exploration, critical thinking, and collaboration. Students were encouraged to take ownership of their learning, build confidence, and develop a deeper understanding of the material, which contributed to meaningful skill development.

The strategy aligned with constructivist principles, positioning students as central to the learning process. It enabled them to practice problem-solving, inquiry-based learning, and self-assessment through structured and sequential tasks at each station. These elements not only supported the development of visual thinking and self-learning skills but also enhanced student motivation and engagement, making the learning process more dynamic and effective.

The study's findings are consistent with prior research, such as Ibrahim (2021) and Eid (2020), which highlighted the role of digital learning stations in improving academic skills and motivation across different educational contexts. This underscores the potential of digital learning stations as a transformative teaching strategy, particularly in subjects like history and social studies, which require critical analysis and conceptual understanding.

In conclusion, digital learning stations are a powerful tool for modern education, offering a student-centered approach that fosters independence, critical thinking, and meaningful engagement. By providing diverse and interactive learning opportunities, this strategy has the potential to significantly enhance student outcomes in both cognitive and self-learning domains.

7. Recommendation

In light of the findings, the study recommends the following:

1. Encouraging history teachers to utilize the digital learning stations strategy in teaching history due to its positive impact on enhancing visual thinking and self-learning skills.
2. Organizing training courses by educational supervisors to train history teachers on how to apply the digital learning stations strategy in teaching history.

Declarations

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Declaration of Interest. The authors declare no competing interest.

Data Availability. Data generated or analyzed during this study are available from the authors on request.

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