

Received: October 2023 Accepted: December 2023

DOI: <https://doi.org/10.58262/ks.v12i1.154>

The Impact of Using Science-Fiction on Developing Visual Memory Skills Among Students With Learning Disabilities

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Abstract

This study proposed an instructional program based on science fiction to improve students' visual memory skills in the elementary stage. The study also identified the extent to which there are differences between the average grades of female students in the experimental group and the control group on the post-test of visual memory skills. The study used the descriptive method and the quasi-experimental method. The study sample consisted of 80 fifth-grade students with learning disabilities from different schools in Irbid City, who were split into two equal groups, one experimental and another a control. The findings of the study showed that the program based on science fiction achieves effectiveness in developing concepts and visual thinking skills, which are: (recognizing and describing visual shapes, interpreting and perceiving ambiguity, extracting visual meanings, analyzing visual shapes, and visual distinction among fifth-grade students. The results confirm that adopting the proposed program using different strategies based on science fiction helped the students acquire scientific concepts related to the unity of light and optics.

Keywords: *Visual Memory, Science Fiction, Students With Learning Disabilities, Science Subject.*

Introduction

The current era has witnessed a diversity of methods for teaching science, emerging from the scientific revolution and progress, which has affected all areas of life, including educational institutions. Therefore, students, whether regular or those with learning disabilities are facing this rapid increase in knowledge. The science teacher has a major role to play in teaching students effective learning instead of focusing on cognitive quantity. Therefore, teachers must focus on four dimensions, as mentioned in the UNESCO report issued in 1996: "We learn to know, and we learn to do; we learn to coexist with others; and we learn to achieve our hopes and aspirations" (Zaytoun, 2002, p. 1). Given that science is one of the basic subjects that is distinguished by its amount of knowledge, concepts, and different skills, teaching it requires a variety of programs and teaching methods that help simplify learning. Its teaching is no longer limited to receiving information, but rather the interest has become in explaining information by focusing on the positive role of the learner and the learners' acquisition of different thinking skills and linking them to reality (Abdel-Kader, 2018).

Science fiction is one of the most important mental activities that humans use, from which people can imagine things that do not exist and are closely linked to the reality in which we live (Khasawneh, 2022). To teach science through science fiction, programs rely on different strategies, including the strategy of telling stories, the strategy of watching science fiction films followed by seminar sessions, the strategy of brainstorming sessions to produce unfamiliar ideas, the strategy of cooperative learning to produce ideas suitable for science fiction stories, the strategy of role-playing and talking with unfamiliar characters, the

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strategy of using the method of connections, and the strategy of completing proposed beginnings and building on the endings given in science fiction stories. For science education to be more effective, the learner must have a solid foundation that helps him link new information, and make the learner aware of the concepts and knowledge he already has (Abdel Salam, 2011; Zaytoun, 2002; Al-Najdi et al., 2005). Concepts are the basic building blocks in the cognitive structure of science, and scientific concepts are considered one of the outcomes of science that are related to science.

The thinking process is an activity that distinguishes human beings from other living beings. Man has used different patterns of thinking to reach knowledge, search for explanations for the phenomena that surround him, or find a solution to the issues and problems facing him, such as inductive thinking, critical thinking, Creative thinking, contemplative thinking, and visual thinking (Black & Barnes, 2021).

Visual thinking is a non-analytical, non-algorithmic style that consists of the intersection of three strategies: thinking by design, thinking by vision, and thinking by visualization. It depends on two processes, vision and imagination, and abstract laws related to the educational situation. Visual thinking precedes visual imagination. (Obaid & Afaneh, 2003, p. 43). Wilman (1993) defines visual thinking as the individual's skill to imagine and present an idea or information using pictures and drawings instead of a lot of filler that we use in communicating with others. Visual thinking relies on description, interpretation, inference, and differentiation of the visual form. Science fiction is closely linked to thinking (Davson-Galle, 2018). The ability to imagine is associated with a particular way of thinking, including the capacity to comprehend and integrate cognitive structures and processes, plan and coordinate activities, communicate, envision alternative solutions, get past barriers and obstacles, and generate new ideas.

Problem Statement

The mental processes that depend on vision and imagination are derived from the learner's past, present, and future experiences with imagined images and science fiction. They can develop visual thinking skills, whether the focus is on the tangible visual form or not. Through the researchers' work in the field of science teaching, they noticed the difficulty of reading and creating visual images of what students learned in the science subject and linking them to the present, past, and future. Therefore, the researchers decided to prepare a program based on science fiction that includes three strategies (the strategy of science fiction stories, the role-playing strategy while impersonating unfamiliar characters, and the strategy of science fiction films). These strategies were selected because of their suitability to the nature of the target group, the psychological characteristics of the students, and the educational environment's need for strategies that focus on the active role of the students, as in the role-playing strategy. It is important to highlight the positive role of the students in focusing on many senses, the most important of which are hearing and sight in the strategies of science fiction stories and science fiction films, in addition to the motor and emotional aspects and the active mental aspect in perceiving and imagining images after they reach the students' imagination to create imaginary images related to science. This study attempted to reveal the effectiveness of the program in helping students with learning disabilities in the fifth grade in Irbid City, Jordan, to acquire scientific concepts and visual memory skills.

Questions of the Study

- 1- Are there statistically significant differences between the average scores of the experimental group and the average scores of the control group in the post-test of scientific concepts?
- 2- Are there statistically significant differences between the average scores of the experimental group and the mean scores of the control group in the post-visual memory skills test?

Objectives of the Study

The purpose of this study is to achieve the following objectives:

- Developing concepts and visual memory skills through a program based on science fiction for fifth-grade students in Irbid.
- Identifying the extent to which there are differences between the average grades of students in the experimental group and the average of the control group on the scientific concepts post-test.
- Identifying the extent to which there are differences between the average grades of female students in the experimental group and the control group on the post-test of visual memory skills.

Significance of the Study

This study may benefit researchers in the field of curricula and teaching methods by providing a program based on science fiction to teach science to students with learning disabilities in the elementary stage. The results may benefit teachers in employing science fiction in the classroom, as the study provides suggested strategies for the program. It may benefit supervisors and teachers by providing a program based on science fiction, testing scientific concepts, and testing visual thinking skills. It may benefit decision-makers in the Ministry of Education by enriching the science curriculum with science fiction through the proposed program.

Limitations of the Study

This study was limited to fifth-grade students to whom the experiment was applied during the second semester of the school year 2022-2023. This study was limited to a random sample of fifth-grade students from different schools in Irbid. The results of the study were limited to the sincere application of the designed program in the classroom by the teachers.

Literature Review

Imagination and thinking are vessels that complement each other. Imagination is a set of ideas that can be seen, heard, sensed, or tasted. We interact mentally with everything through images. The processes of imagination and thinking are among the divine processes that paved the way for humans to reach facts that were not possible to perceive through the senses (de Oliveira Moraes et al., 2021). Visual thinking skills are one of the vessels of imagination that help in developing the learner's language, attracting interest and increasing motivation, organizing thoughts, and training to express ideas. They are also important in developing imagination and higher mental processes and acquiring the visual language that increases the ability to communicate and interact with others and work the mental images and their organization in the mind (Dou et al., 2019).

Science Fiction

Jordan and Silva (2021, p. 35) defined science fiction as “the mental activity represented in imagining things that do not exist based on past and present experiences; that would clarify the past, improve the present, and develop the future.” Karadeniz and DEĞİRMENÇAY (2020) defined it as “a mental activity through which an individual can form unique mental images of new things in the field of natural sciences, based on his previous scientific experience, what the present scientific capabilities provide, and the predictive vision for the future of science.” Science fiction is a mental activity through which the individual contemplates the possible changes that may occur in the near or distant future regarding the topics of the science subject that he is studying at present so that he is prepared

for those expected changes based on his previous experience by practising the processes of research and investigation while studying these topics, which are space travel, discovering the secrets of the universe, and the possibility of life on other planets (Rothenberger, 2019).

Among the characteristics of science fiction is to be verifiable, that is, the events recorded in the science fiction story will come true one day, whether in the present or the future. The stories must base their events on science and its facts; that is, science fiction stories take science and its discoveries as their starting point and rely on myths or imagination. It is fantasy mixed with scientific facts and an attempt to imagine human interaction with scientific progress. Science fiction stories predict possible future events (Manià et al., 2018). Many science fiction stories suggest scientists' ideas related to the fields of science. The importance of science fiction stems from developing children's creativity, their ability to think critically and creatively, and their problem-solving skills in a creative way, which contributes to developing the child's scientific thinking skills. It also develops the child's scientific culture by encouraging children to read and learn and satisfying their love of curiosity.

By reviewing the educational literature, it became clear that science fiction was used in the educational process, and its results were fruitful. It was used in developing various methods for improving mental activity, whether imagination is activated for an independent spontaneous activity or through school program activities done by the teacher (Saade, 2022). Science fiction became a model that helped create a climate of diversity and continuous integration between what is unreal (imaginary) and what is realistic. It is not required to develop the ability to remember, memorize, or understand, but rather to activate the element of imagination in the learning process by achieving integration between the elements of memory and the elements of imagination that can release the creative state in the individual (Tang, 2014).

Visual Memory Skills

Words have a second language. We can translate both written and spoken words into movies and colourful pictures that we support with sound. When a person speaks so and so, his words are translated into pictures immediately (Yilmaz Korkut & Sasmaz Oren, 2018). Visual expression is familiar to people, as it is one of the common uses and one of the basic means of forming and processing the mental image in ordinary life. Visual thinking is a mental ability linked to the visual and sensory aspects. This type of thinking occurs when there is mutual consistency between what the learner sees in shapes, drawings, and relationships and the connection that occurs and mental products based on vision and the displayed drawing (Vrasidas et al., 2018; Khelil et al., 2023). It is also a pattern of thinking based on visual perception, which is intended to form and process mental images. It entails a system of processes that translates an individual's ability to read a visual form, transform the visual language that form carries into written or spoken verbal language, and extract information from it (Liu, 2019).

How knowledge is retained and recalled is a crucial component of learning. To store knowledge and, when needed, retrieve it, memory is essential. People's memories are impacted when they actively engage in the writing-based DST process (Manià et al., 2018). Additionally, prior research has shown that storytelling—including digital storytelling—can positively affect memory. Retaining and recalling prior experiences and events is the process of memory. Memory has been categorized or termed in several ways and serves a multitude of purposes. The capacity to retrieve or retain words, images, sceneries, or other information that is visually presented is known as visual memory. Visual thinking is a style of thinking that is neither analytical nor algorithmic and consists of the intersection of three strategies: thinking by design, thinking by vision, and thinking by visualization (Black & Barnes, 2021). Vision is the visual perception of two- and three-dimensional objects and the

connection of these perceptions with the viewer's past experiences. Perception includes realizing different roles for given objects and being aware of alternative realities.

Previous Studies

Saade (2022) illustrated how science fiction books, movies, and video games may improve high school students' scientific literacy. This study examines how science information may be taught through an analysis of certain science fiction books, movies, and video games, even if there are many other ways to teach scientific principles. High school instructors might utilize these materials—whether they take the shape of books, movies, or video games—as a starting point to explain scientific ideas and social issues in ways that complement their current science curricula and learning objectives. When used intelligently, science fiction literature may help kids acquire the critical and scientific thinking skills necessary to become scientifically literate citizens through imaginative play and reading.

Gibson (2018) used the theoretical framework of disability studies to analyze the book *Transmetropolitan*. The goal is to show how science fiction, and specifically this series, can both exemplify and shape our understanding of disability, impairment, and difference. This paper seeks to encourage readers to consider more imaginatively how narratives that appear to be unaffected by disability can be informed and understood via disability theory. Specifically, it does this by illustrating how *Transmetropolitan* can be used for the disabling potential of society as experienced by individuals with impairments.

Vrasidas et al. (2015) designed a project that gives teachers the resources, instruction, and direction they need to improve their science instruction, engage students in science, relate science to current events like environmental issues, and give girls and other marginalized groups access to science opportunities. This document aims to provide the project's structure and lessons learned from its design and implementation. We concentrate on the following subjects: (1) Sci-Fi narratives' theoretical and empirical foundations: the value, advantages, and difficulties of narratives in education; (2) interdisciplinary teaching and learning: the advantages and difficulties of the interdisciplinary approach; (3) useful advice and creative teaching concepts: introducing Sci-Fi-Ed; and (4) a succinct discussion of the lesson discovered during implementation.

Alghamdi and Alotaibi (2022) explored the value of employing science fiction as an inspiration for story writing to support scientific education for female Grade 10 Saudi Arabian students. Data from classroom observations, teacher interviews, and a content analysis of the two homework projects completed by the students are all included in the case study report. A content analysis verified that students used science facts accurately and used their imagination to create imaginative stories that reflected their value systems. They placed high importance on identity, social acceptance, respect and validation, long-lasting friendships, communication and discourse, safety, and family. About the God/Crustacean debate, their goals were to live in a clean, safe, joyful, and peaceful environment. The results of the study demonstrated the need to look at how science fiction is used in Saudi scientific education.

Rothenberger (2019) examined how middle school children with learning difficulties acquired vocabulary about graphic novels vs standard text. Students took a pre-test to gauge their understanding of 10 vocabulary words that were used in different versions of the book *Coraline* before reading a section of either one. The usage of the graphic books and traditional text was the independent variable, while the word definitions were the dependent variable. Students performed vocabulary post-tests to define the same 10 terms after reading multiple pages. The results are analyzed in light of prior and upcoming studies and indicate that the graphic book provided more correct replies than the regular text.

Methodology

Research Design

The researcher used the descriptive method and the quasi-experimental method. This is due to their suitability to the nature of the aim of this study. The descriptive approach is a precise, systematic way to describe and analyze the phenomenon or issue that will be studied using a scientific methodology. The goal is to obtain scientific results and interpret them in an unbiased, objective manner that advances the goals and hypotheses of the study (Al-Jubouri, 2012). The quasi-experimental is the method by which the researcher identifies the various conditions and variables that appear in the investigation of information related to a phenomenon, as well as controlling and controlling such conditions and variables.

Sampling

The study sample consisted of 80 fifth-grade students with learning disabilities from different schools in Irbid City, from which two divisions were selected by a simple random method. One of them was the experimental group, which numbered (40) students, and the other was the control group, which numbered (40) students. The approval to conduct the study was obtained from the Directorate of Education in Irbid City.

Instrument of the Study

Visual Memory Test

The researcher prepared a test of visual memory skills to measure the extent to which fifth-grade students have acquired visual thinking and visual memory skills in the science subject. The researcher reviewed previous studies to learn how to measure visual memory skills to identify visual thinking skills and formulate test items based on scientific methods.

The study verified the validity of the test by sending it firstly to a group of nine university professors who specialize in curricula, teaching methods, and science. They expressed their opinions and observations regarding the appropriateness of the test items, the extent to which the items belong to each dimension of the test, as well as linguistic and scientific accuracy, to reach the clearest formula for the test items. Their observations were taken into account, and amendments were made, including deletion and addition. The test remained composed of 30 questions.

The reliability of internal consistency means the strength of the correlation between the scores of each field and the total score of the test, as well as the degree of correlation of each item of the test with the total score of the skill to which it belongs. The validity of the internal consistency of the test was verified on a sample consisting of 43 students from outside the sample, and the Pearson correlation coefficient was calculated between the scores of each test item and the total score of the test to which it belongs. The following table presents the results.

Table 1: Correlation Coefficients Between Each Field And The Total Score of The Visual Memory Skills Test.

Skill	correlation coefficient	Sig.
Identify and describe the visual form	0.86**	0.01
Interpretation and perception of visual ambiguity	0.65**	0.01
Extracting visual meanings	0.73**	0.01
Visual shape analysis	0.48**	0.01
Visual discrimination	0.51**	0.01

It is clear from Table 1 that all skills are statistically significantly related to the test's total score at

the significance level (0.01). This indicates that the test is characterized by internal consistency.

Science Fiction-Based Program

The program was designed after reviewing previous works on the use of science fiction in education. The proposed program aims to develop scientific concepts and visual memory skills included in the general science subject for the fifth grade. The researcher chose three strategies based on science fiction because of their suitability to the nature of the target group, the psychological characteristics of students, and the educational environment's need for strategies that focus on the active role of students. The role-playing strategy and the positive role of students in focusing on many of the senses, the most important of which are hearing and sight, in the science fiction story strategies. Science fiction films, in addition to the motor and emotional aspects and the active mental aspect of perceiving and imagining images, help students reach their imagination to create imaginary images related to science.

The contents of the lessons of some units were organized by defining the general objectives related to the program and the targeted unit, preparing the lessons, writing science fiction scenarios, and determining appropriate means of evaluation and reinforcement. After preparing the initial version, it was presented to a group of judges, who provided their opinions on the format of the programs and suggested that the wording of some lessons be modified. The program was controlled through the exploratory application of the program by applying it to a survey sample of (20) fifth-grade students, who were selected randomly from outside the study sample, to determine the suitability of the program for application, and the suitability of the specified period for the lessons of the study unit and revealing the difficulties that students and teachers will face during the application.

Study Procedure

The researcher followed the following steps to achieve the objectives of the study:

- Reviewing educational literature and previous studies related to science research.
- Preparing a list of visual thinking skills.
- Building a visual thinking skills test and presenting it to specialists for appropriate modifications, and considering their opinions.
- Preparing a program based on science fiction using some strategies, and testing it on a pilot sample to determine its suitability for application and suitability of period.

Data Analysis

The standard deviations and mean scores of students' responses to the tests were extracted. A t-test for two independent samples was used to verify the questions. Planck's gain coefficient to detect the effectiveness of the program, eta square to detect the effect of the program, and to find the size of the effect of the independent variable on the dependent variable.

Results and Discussion

Results of the First Question

To answer the first question, a t-test was used for two independent samples to reveal the significance of the differences between the mean scores of the performance of the participants in the post-test of scientific concepts. Table 2 presents the results.

Table 2: Results of the T-Test for Two Independent Samples Between the Average Scores of Students in the Experimental and Control Groups on the Post-Test for Developing Scientific Concepts.

Dimension	Group	Number	Mean score	Standard deviation	T value	Sig.
Remembering	Control	40	3.25	1.01	4.36	**0.01
	Experimental	40	4.20	0.94		
Understanding	Control	40	10.50	2.81	2.80	**0.01
	Experimental	40	12.10	2.27		
Application	Control	40	3.38	1.72	4.90	**0.01
	Experimental	40	5.00	1.20		
Upper skills	Control	40	5.08	1.44	4.78	**0.01
	Experimental	40	7.08	2.22		
Total	Control	40	22.20	5.52	4.93	**0.01
	Experimental	40	28.38	5.69		

**statistically significant at (0.01).

It is noted from Table 2 that the calculated “t” value for the total score of the scientific concepts test was 4.93, which is greater than the tabulated “t” value at the significance level (0.01), which is equal to 2.66. Accordingly, there are differences between the average scores of the students of the control group and the scores of the students of the experimental group in the post-test of scientific concepts in favor of the experimental group. To calculate the effect size, the Eta square was used as shown in the following table

Table 3: The Size of The Effect of The Independent Variable (The Science Fiction-Based Program) on the Dependent Variable (Concept Development).

Dimension	Test	Number	Mean score	Standard deviation	T value	Eta square	D value	Effect size
Remembering	Pre-test	40	2.03	0.89	9.39	0.69	2.50	High
	Post-test	40	4.20	0.94				
Understanding	Pre-test	40	6.33	2.49	9.45	0.70	2.52	High
	Post-test	40	12.10	2.27				
Application	Pre-test	40	2.38	1.28	10.85	0.75	3.01	High
	Post-test	40	5.00	1.20				
Upper skills	Pre-test	40	2.45	1.77	10.07	0.72	2.74	High
	Post-test	40	7.08	2.22				
Total	Pre-test	40	13.18	4.13	12.18	0.79	3.47	High
	Post-test	40	28.38	5.69				

It is clear from Table 3 that the value of “t” for the average score of students in the scientific concepts test was (0.79) and that the value of “d” was (3.47). This indicates that the program based on science fiction has a very large effect on the dependent variable, with a very great degree of effectiveness. It was shown that the areas of memory, understanding, application, and higher education have a great impact.

The findings demonstrated that when it came to evaluating scientific knowledge, the experimental group's pupils did better than the control group's. The researcher attributes this to the fact that using the program based on science fiction with various strategies, such as science fiction stories, role-playing while impersonating unfamiliar characters, and science fiction movies, led to the students forming mental images in their imagination that helped give meanings to words and concepts.

The researcher noticed that the students interacted positively and quickly absorbed and recalled the scientific concept (Gibson, 2018). This is an indication that the concept remains in the cognitive structure within the learner’s mind for a longer period, which helps in creating new meanings for the ideas learned and helps connect previous and new learning, and thus learning becomes effective and meaningful. Students with disabilities can benefit from this technique in their learning process, especially when learning scientific materials. The program was designed to improve the cognitive skills that help students recollect and remember ideas quickly.

Results of the Second Question

To answer the second question, a t-test was used for two independent samples to reveal the significance of the difference between the average performance in the post-test of visual memory skills for both the control group and the experimental group as shown in the following table.

Table 4: Results of The T-Test For Two Independent Samples Between the Average Scores of Students in the Experimental and Control Groups in the Post-Test for Developing Visual Memory Skills.

Dimension	Group	Number	Mean score	Standard deviation	T value	Sig.
Identify and describe the visual form	Control	40	5.90	0.78	3.44	**0.01
	Experimental	40	6.50	0.78		
Interpreting and understanding ambiguity	Control	40	3.85	1.08	4.43	**0.01
	Experimental	40	4.70	0.56		
Extracting visual meanings	Control	40	3.38	1.41	5.43	**0.01
	Experimental	40	5.70	1.67		
Visual shape analysis	Control	40	1.33	0.73	5.98	**0.01
	Experimental	40	2.35	0.80		
Visual discrimination	Control	40	4.03	1.25	3.52	**0.01
	Experimental	40	5.03	1.29		
Total	Control	40	18.93	3.42	6.75	**0.01
	Experimental	40	24.28	3.66		

It is noted from Table 4 that the calculated “t” value for the total score of the visual thinking skills test is equal to (6.75), which is greater than the tabulated “t” value at the significance level (0.01) and is equal to 2.66. Therefore, there are statistical differences between the average scores of the control group and the scores of the experimental group in the post-test of visual thinking skills in favour of the experimental group. To calculate the effect size, the Eta square was used as shown in the following table.

Table 5: The Size of The Effect of the Independent Variable (The Science Fiction-Based Program) on The Dependent Variable (Visual Memory Skills).

Skill	Test	Number	Mean score	Standard deviation	T value	Eta square	D value	Effect size
Identify and describe the visual form	Pre-test	40	3.20	1.31	13.71	0.83	4.00	High
	Post-test	40	6.50	0.78				
Interpreting and understanding ambiguity	Pre-test	40	2.35	1.23	10.98	0.76	3.06	High
	Post-test	40	4.70	0.56				
Extracting visual meanings	Pre-test	40	2.63	1.23	9.38	0.69	2.50	High
	Post-test	40	5.70	1.67				
Visual shape analysis	Pre-test	40	0.90	0.74	8.83	0.64	2.15	High
	Post-test	40	2.35	0.80				
Visual discrimination	Pre-test	40	1.88	1.20	11.29	0.77	3.16	High
	Post-test	40	5.03	1.29				
Total	Pre-test	40	10.95	3.60	16.42	0.87	4.92	High
	Post-test	40	24.28	3.66				

It is clear from Table 5 that the value of the Eta square was (0.87) and the value of “d” was 4.92. This indicates that the program based on science fiction has a very large impact on the dependent

variable (visual memory skills) and a very large degree of effectiveness. The outcome of the visual thinking skills exam revealed that the experimental group's kids fared better than the control group's. The researcher attributes this to the fact that using the program based on science fiction with various strategies, such as the strategy of science fiction stories, role-playing while impersonating unfamiliar characters, and science fiction movies, led to the students performing mental processes that helped transform the imagined mental image into a tangible image, or vice versa.

The program developed their ability to visually distinguish tangible shapes, perceive relationships, interpret ambiguity, analyze visual form, extract and deduce meanings, and thus arrive at a scientific concept and acquire visual thinking skills (Liu, 2019). The program provided the students with an opportunity to develop their skills through developing the ability to think visually. Despite the challenges this category of students face in their daily routine, some programs, including the proposed program in this study, can enhance different skills to help students improve their learning.

Conclusion

The findings of this investigation revealed that the program based on science fiction achieves effectiveness in developing concepts and visual thinking skills, which are: (recognizing and describing visual shapes, interpreting and perceiving ambiguity, extracting visual meanings, analyzing visual shapes, and visual distinction among fifth-grade students. The results confirm that adopting the proposed program using different strategies based on science fiction helped the students acquire scientific concepts related to the unity of light and optics, which were visualized and expressed verbally and in writing at the beginning, during, and at the end of the lesson. The program provided an opportunity to use examples from reality, which helped students maintain the impact of scientific concepts and recall them at any time, and this became clear during the active participation of female students in the experimental group compared to the control group.

Recommendations

The study recommends the necessity of using educational programs based on science fiction in teaching science because of their role in developing concepts and visual thinking skills and training teachers to build and activate them. It is also important to build programs based on science fiction for all academic levels. The researcher recommends holding courses and workshops for teachers to introduce them to how to better activate and develop the program. Schools can hold training courses related to content analysis based on visual thinking skills and other types of thinking.

Acknowledgment

The authors extend their appreciation to the Deanship of Scientific Research at King Khalid University for funding this work through Small Research Groups under grant number (RGP.1 /282 /44).

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