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The Effect of the Science Stations Strategy on Developing Biological Concepts and Acquiring Science Operations Skills among Classroom Teacher Students at Al-Isra University

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Abstract

This study investigated the effect of using the scientific station's strategy in developing biological concepts and acquiring science operations skills among classroom teacher students at Al-Isra University in Jordan compared to the usual method. The study was applied to a sample of (61) female students from the Department of Class Teacher and Records in Life and Health Sciences. The two classes were randomly assigned to an experimental group of (30) female students and a control group of (31) female students. The researchers used the quasi-experimental approach. To achieve the study objectives, a conceptual test consisting of (25) items was prepared to measure the level of development of biological concepts, as well as a scale comprised of (20) items was ready to measure the level of acquisition of science operations skills among the study members. The psychometric properties of the study tools were verified, and the results showed a statistically significant effect at the significance level (a=05.0) for the strategy of scientific stations in developing biological concepts and acquiring science operations skills for the benefit of the experimental group.

Keywords: *Strategy of Scientific Stations, Development of Biological Concepts, Acquisition of Science Processes.*

Introduction

Theoretical Framework

Quality is an essential element for any institution that provides its services in a globally competitive manner. Universities are the first institutions entrusted with preparing specialists for all sectors of society; the quality of education within university institutions means preparing a graduate who can perform his role with a high efficiency comparable to international universities, and from this axis stems the quality of educational programs, study plans, and teaching methods, their originality, the extent of their comprehensiveness and their absorption of the variables, the recent developments of the knowledge revolution and the extent of their contribution to the formation and refinement of the student's personality.

The most prominent of these strategies is the strategy of scientific stations that focus on the learner's active role and encourage him to build his knowledge by carrying out many different and varied educational experiments and activities (Al-Zahrani, 2018). In contrast, the strategy of scientific stations designed by Dennis Jones is one of the strategies that can be used in teaching scientific concepts and acquiring science operations skills because it enhances the effectiveness of the student inside and outside the classroom and works to develop his abilities and participation in building his knowledge and pushes him to positive interaction and teamwork through research and exploration through direct and effective interaction with his teacher and his colleagues (Jones, 2007).

Ambusaidi and Al-Balushi (2018) defined the strategy of scientific stations as a teaching method based on educational activities in which students move in small groups through successive and sequential stations, which allows students to interact with these activities and provide information and knowledge on their own.

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It was defined by Bulunuz and Jarrett (2010) as practical training on activities by working in groups over a series of stations. Suleiman (2015) defined it as a set of various scientific activities from which students draw scientific knowledge in many ways that consider the individual differences among them and work on developing creative and reflective thinking skills and soundly acquiring scientific concepts. He stressed that the strategy of scientific stations affects the student's ability to develop habits of mind and modify alternative concepts, which contributes to raising their achievement and providing them with multiple science processes. The strategy of scientific stations is based on several intellectual trends, including the constructivist approach, which focuses on the importance of the learner's active role in building his knowledge by presenting situations and problems that challenge his thinking (Al-Shammari, 2011). Moreover, the exploratory trend focuses on helping the learner discover ideas through experiments and activities, in addition to the investigative trend, which allows the learner to develop his thinking and practice various science processes to create learning based on understanding. (Gercek, Ozen, 2016).

The strategy of scientific stations is used to overcome the problem of lack of resources and tools by providing tools for only one group instead of providing them to all groups. Al-Ankabi (2014) pointed out several advantages of using the scientific station's strategy in teaching and focusing on the positive role of the learner through his participation in the implementation of practical experiences and his practice of various science processes, in addition to diversifying practical and theoretical experiences to meet the learner's educational needs.

Despite the many advantages of the scientific station's strategy, the teacher notices some shortcomings while employing it. One is that implementing this strategy requires much effort, especially during the planning and teaching stages. Another is that this strategy requires the availability of large classroom spaces so that station tables can be organized and moved between them quickly (Ambosaidi & Al Balushi, 2018; Jones, 2007).

There are different types of scientific stations, which depend in their design on the nature of scientific concepts and the time available at each station, which is: in order to overcome this shortcoming, Boschen (2018) mentioned some tips to increase the effectiveness of employing this strategy, such as: making sure that the classroom space is appropriate for scientific stations and their equipment, such as worksheets, reading resources, materials, and tools needed for each station, and training students on how to work in each station. (Boschen, 2018).

The investigative/exploratory station allows the learner to practice activities and laboratory experiments. **Reading station:** This allows the learner to look at books, magazines, and references to extract knowledge from their sources to train learners to develop independence skills in education. **The visual station** is characterized by pictures or drawings that help students bring scientific concepts and tangible experiences closer to their minds. **Audio/visual station:** This provides activities targeting the senses of hearing and vision by providing videos and films related to the lesson's topic. **The electronic station** depends on displaying various media and presentations on the computer. Alternatively, search online**; consultation station:** in which experts in a specific field, such as a doctor or engineer, are hosted to be asked questions by students to expand their awareness of the various aspects of the scientific subject. **Wax Museum Station:** It includes a simulation of a scientific or historical figure related to the lesson's topic. **The (yes) and (no) station:** This station is considered one of the fun and thought-provoking stations for students, where the students ask the expert a set of questions, to which he answers only yes or no. (Ibrahim, 2021; Ambosaidi and Al Balushi, 2018; Jones, 2007; Rogayan, 2019).

During this strategy, the learner passes various experiences that suit his needs. He exercises kinetic activities while moving between stations and engages in science processes such as observation and conclusion to arrive at new concepts. He discusses and interviews his colleagues at the station, cooperates with them in solving activities, and asks various questions. In light of this, the teacher exercises several organizational and guiding roles, including Determining the types of stations he will design in line with the lesson objectives, the nature of the content, and the available capabilities—organizing the classroom in proportion to the movement of demand between stations. Moreover, each station should have tools, resources, and worksheets. Moreover, the instructions students need while moving between stations in small groups, then

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choose the appropriate method to move between stations and determine the time allotted to stay at each learning station.

Managing classroom discussions and providing feedback to students. Moreover, the time to end the movement between stations and direct the students to return to their seats. (Ibrahim, 2021; Ambusaidi and Al-Balushi, 2018; Al-Lahibi (2015).

There are several methods for organizing the steps of using the strategy of scientific stations, including circumambulating all stations. By distributing students in groups to visit all stations, the movement clockwise, and then the process of discussing worksheets and group results at each station begins and circumambulates half of the stations: when some activities require a longer time, which requires shortening the number of stations in half. **Fragmented education:** By distributing the members of one group to the different stations, each member visits only one station, then they meet after the end of the specified time, and each student discusses what he did in the station he visited and exchanges experiences among themselves. Nawasra and Karasneh (2020) (Vosniadou, 2019) and Maykhan (2019).

Teaching science seeks to functionally develop students' scientific concepts by linking new knowledge with relevant prior knowledge (Mustafa, 2014). Scientific concepts are one of the components of scientific knowledge and building blocks for learning science because of their importance in organizing the educational experience, linking it to its sources, and facilitating access to it (Ambo Saidi & Al Balushi, 2018). Educational literature emphasizes that learning scientific concepts is linked to meaningful learning because it can give meaning to learning, achieve understanding and scientific communication, and help students transfer the impact of learning, organize experience, and reduce re-learning (Khataiba, 2011). Teaching scientific concepts is characterized by the presence of an educational learning format that allows the student to explore and inquire on the one hand and, form the concept and use it in different situations on the other hand (Peter, 2014). Given the importance of learning scientific concepts, many educational studies have dealt with the subject of concepts that the student forms for many phenomena and situations and indicated that the student, as a result of his interaction with the environment in which he lives, forms multiple types of sound concepts, which requires an appropriate teaching method that ensures the integrity of their formation, survival, and retention. (Vosniadou, 2019). In addition to teaching and developing scientific concepts among students, the development of science operations skills is one of the primary objectives of science education and science teaching, as the learner's acquisition of these operations benefits him in the educational process on the one hand. On the other hand, solving the problems encountered in different life situations, as Myers & Dyer (2006) indicated that teaching scientific concepts should focus on providing learners with the skills of science processes because they are the basis of the inquiry process and discovery.

Ambosaidi and Al-Balushi (2018) emphasized that using science operations skills encourages the learner to think and acquire information and skills practically instead of memorizing information and memorizing when needed. Valentino believes that students of all ages can gain direct sensory experiences and explore their environment through the practice of various science processes. Science processes help students deal intelligently with daily life's problems in a manner characterized by accuracy and objective flexibility. Moreover, it improves the student's thinking through the actual practice of mental operations to access information by himself instead of giving it to him with the teacher's help.

The opinions of educators about the classification of science processes have differed. The current study will depend on the classification included in the report prepared by the American Association for the Advancement of Science (AAAS), which includes two types of operations: Basic science processes: It includes, including observation, measurement, classification, communication, the use of numbers, prediction, the use of temporal and spatial relationships. Moreover, integrative science processes include procedural definition, experimentation, interpretation of data, controlling variables, and formulating hypotheses (Zeitoun, 2011).

Al-Zahrani (2018) indicated a strong relationship between the strategy of educational stations and science operations, as learning in the light of the strategy of scientific stations attracts learners, especially in the exploration station. This helps to acquire science processes through discussion, exchange of views,

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participation, and experimentation, and reading pictures and illustrations away from the stereotypical situation and getting out of the circle of memorization and indoctrination contributes significantly to the development of science processes among students and since the strategy of the scientific stations, including the various opportunities it provides, while passing through the stations, allows the student to practice the various science operations. The exploratory station presents the student with a specific question that he must follow the scientific steps and practice the scientific skills that include observation, inferring the relationships between information and linking them, and classifying the information according to groups based on the degree of similarity between these groups. The visual and electronic station requires the students to read the pictures, observe them, and follow the presentations, including pictures and illustrations that address the different senses, such as the sense of sight, thus developing the observation skill. In addition, the worksheets for each station contain stimuli that require using various science processes, such as observation, classification, and conclusion (Ibrahim, 2021; Ambosaidi & Al-Balushi, 2018; Al-Lahibi (2015).

The issue of using the strategy of scientific stations has also recently attracted the attention of several researchers at the international and regional levels. Several studies have been conducted on the impact of using the strategy of scientific stations in teaching as follows:

Twizeyimana et al. (2024). This research uses quantitative data analysis and descriptive and quasi-experimental research techniques; it is a mixed-methods study. According to the results, students' performance on a Chemistry Achievement Test differed significantly between the control and experimental groups ($t = 5.66$, $p < 0.05$). Our findings also show that educators are enthusiastic about and ready to implement inquiry-based learning. They hope that by including hands-on activities in the curriculum, kids will develop a passion for science and learn the fundamentals of the scientific method. This study promotes the potential advantages of inquiry-based learning for improving science education by adding to our knowledge of the relationship between teachers' viewpoints, instructional strategies, and students' understanding of the scientific process.

Cortes et al. (2024). This study examined the efficacy of a science teacher professional development program that included four years of creating, implementing, and publishing participatory action research projects. Science educators from one school who participated in the program's professional development sessions led by experts from another university made up the sample. To evaluate the program's efficacy and the instructors' development, researchers used a mixed-methods strategy, collecting quantitative and qualitative information. The professional development program's efficacy was assessed using Guskey's (2000) five-level evaluation approach. Teachers' responses, learning, organizational change and support, application of new information and abilities, and student learning results were all part of the evaluation. The program significantly impacted all five stages of Guskey's approach, including mentorship on action research problem formulation through to publication. Educators' proficiency with action research increased, leading to their work's publication in a respected science education magazine. Results showed that action research mentorship and other research-oriented professional development programs that are collaborative, long-term, and focused on research yielded the best results. Furthermore, it highlighted that professional development programs require an assessment framework to determine their efficacy.

Al-Ayasrah and Abumuhfouz (2023) set out to determine how well elementary school science instructors in Mafraq Governorate understood scientific stations and how that knowledge correlated with their actual classroom methods. One hundred and ten male and female educators were chosen randomly to participate in the descriptive survey used in the study. A two-part questionnaire was administered to gauge the teachers' familiarity with and ability to apply the scientific station's technique. The reliability and validity of the survey were confirmed. Based on the results, elementary school science instructors in Mafraq Governorate knew about the scientific stations approach to a moderate degree. It was also determined that their level of implementing this strategy was moderate. In addition, a robust and statistically significant relationship existed between the extent to which teachers understood and used the scientific station's technique in the classroom. Several suggestions were made in light of these findings. The distribution of informative booklets and pamphlets can help science teachers at the elementary level learn more about the scientific

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stations' strategy, and they can also be encouraged to use a variety of print and digital resources to supplement what they already know.

Ibrahim (2021) conducted a study to develop scientific inquiry skills by building an enrichment program using scientific stations. The study sample consisted of a group of first-year preparatory students; the researcher used the scientific investigation skills test. The results showed a statistically significant difference at the significance level (0.01) between the mean scores of students in the pre-and post-applications to test the scientific investigation skills in favor of the post-application.

Al-Hafidh's (2020) study aimed to determine whether or not the Scientific Stations method was effective in helping students at the intermediate level of science strengthen their deductive reasoning skills. In order to accomplish the research goal, the researcher employed an experimental design with two equal groups. The research sample included 65 boys in intermediate grade from Al Nidhal school; 30 students were assigned to the experimental group and 35 to the control group. The researcher used a set of variables, including intelligence, parents' educational level, previous achievement, age calculated in months, and a pretest for deductive reasoning, to test the following hypotheses: 1-When comparing the posttest scores of the two groups on the Deductive reasoning test, there is no statistically significant difference between the two groups at the 0.05 level of significance. 2-The difference in the mean scores between the pre-and posttests of the experimental and control groups on the deductive reasoning exam is not statistically significant at the 0.05 significance level. According to the results obtained after administering a twenty-item test of deductive reasoning, collecting data, and tabulating it in tables for statistical processing, the research hypotheses were confirmed. 1-On the deductive reasoning test, there is a statistically significant difference between the two groups' mean scores, with the experimental group coming out on top. 2- The experimental group stands to benefit statistically from the pre-posttest's considerable mean difference.

The study of Al-Nawasra and Al-Karasna (2020) aimed to reveal the impact of employing the "smart" learning station strategy on student achievement. The study sample consisted of 120 male and female students from public schools affiliated with the Ramtha District. They were divided into two groups: experimental and control. To achieve the study's objectives, the researchers organized the content according to the strategy of scientific stations and prepared an achievement test. The study results showed statistically significant differences in favor of the experimental group that employed the "smart learning stations" strategy.

The study of Maykhan (2019) also aimed to identify the effect of using the scientific station's strategy on high-ranking achievement and thinking among first-grade students of middle school; for the subject of science, the study sample consisted of (68) students, with (34) students in each of the experimental group and the control group. Two tools were prepared for the study, namely the achievement test and the high-ranking thinking test, and the results showed that the students of the experimental group outperformed the control group in the achievement of science and high-ranking thinking.

Al-Farkahi and Al-Abaji (2019) conducted a study to identify the impact of the strategy of scientific stations in modifying the misunderstanding of scientific concepts among students of the first intermediate grade in the science subject in Baghdad. The study sample consisted of (54) students and (27) students in the experimental and control groups. In light of the results obtained by the researchers, a set of misconceptions must be diagnosed and modified. Modern methods and strategies should be adopted to treat them as the strategy of educational stations because of their impact on modifying misconceptions.

Rogayan (2019) conducted a study to investigate the impact of the learning station strategy on academic achievement and the trend toward biology; the study sample consisted of 28 students in the tenth grade at Luzon Secondary School in the Philippines. The results showed an improvement in the student's achievement in biology and their attitudes toward it after the experimental treatment. There was a positive relationship between educational attainment and the trend toward biology. Al-Zahrani's study (2018) aimed to investigate the impact of scientific stations on academic achievement and the development of science operations skills in science for sixth-grade female students in the life operations unit in the city of Mecca and to achieve the objectives of the study. The researcher followed the quasi-experimental approach by

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designing two experimental groups of 41 female students and a control group of 40 female students. The study tools consisted of an achievement test and a test of science processes whose validity and reliability were verified. The results showed statistically significant differences between the mean scores of the experimental and control groups in the post-measurement of both the achievement test and the science operations test in favor of the experimental group.

Qeshta (2018) conducted a study to reveal the effect of employing the strategies of scientific stations and educational games in developing creative thinking skills in science for seventh-grade students in Gaza. The study sample consisted of 105 female students in the seventh grade in Rafah governorate. The study's results revealed the effectiveness of the strategies of scientific stations and educational games in developing creative thinking skills in science. Al-Tawiji's study (2018) aimed to identify the impact of teaching practical physics using the strategy of scientific stations in developing integrative science processes; the study was applied to a sample of (43) male and female students in the Community College of Aden Governorate. The study tool consisted of a test of the integrative science processes for the practical physics course. The results showed a statistically significant difference at the significance level (0.05) between the mean scores of the two study groups on the post-science operations test for the "Practical Physics" course in favor of the experimental group.

Daoud (2016) also conducted a study investigating the effect of the scientific station's strategy on achievement and habits of mind. The study sample consisted of 42 students from the fourth scientific students in Baghdad; they were distributed into two groups, one experimental and the other controlling. The study tools consisted of an achievement test and a scale of habits of mind; the study concluded that there are statistically significant differences in favor of the experimental group in both tools, and the researcher recommended the need to pay attention to the strategy of scientific stations in teaching biology. Al-Lhaibi's study (2015) aimed to reveal the impact of the scientific stations' strategy on the achievement of second-grade students and their attitude towards physics in Diyala Governorate in Iraq. The research sample consisted of (60) students divided into two equal groups: experimental and control groups. To verify the two hypotheses of the research, the researcher conducted an achievement test for the two groups. The researcher adopted a measure of the trend. The results showed a statistically significant difference at the significance level (0.05) in achievement and attitude towards physics and in favor of the experimental group that studies according to the strategy of scientific stations.

Chamber's (2013) study sought to reveal the effect of using scientific stations on practical training to correct misconceptions in science and its impact on raising academic achievement among students; the study tools were interviews, daily homework, and a questionnaire. The study sample consisted of (49) students divided into two groups. The study results revealed significant progress in the posttest that exceeds what it was during the pretest. The study of Bullunuz and Jarrett (2010) aimed to know the impact of scientific stations assigned to scientific activity in shaping scientific concepts among students who will become primary grade teachers about the concepts of Earth and space sciences in Turkey. In this study, the researchers used the experimental method, where the number of students was 29 students from the second university stage, and the results of the study indicated that there were statistically significant differences in favor of the strategy of scientific stations attributed to scientific activity in the conceptual change of the students of the experimental group. In light of the researchers' briefing and review of previous studies and research, there were no studies available that dealt with the employment of the strategy of scientific stations in acquiring biological concepts and science operations skills among female class teacher students at the undergraduate level, the researchers hope that this study will be a modest and successful contribution, and this will result in the results of the study that will be used by specialists and everyone interested.

Study Problem, Questions, And Hypotheses

Among the requirements of the era of science, technology, communications, computers, and others, the primary goal in science education must be to teach students how to face the challenges of the twenty-first century and how to think with minds capable of challenging and addressing problems and how to deal with and solve them, as well as able to understand and employ scientific concepts and acquire skills of science operations. This can only be achieved through educational activities and dealing with laboratory materials

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and tools to help the learner gain direct experiences not matched by any other type of experience. The information collected found that some faculty members rely on the usual methods that depend on lectures and focus on content. This is not commensurate with the nature of constructivist teaching; it does not achieve its goals or develop scientific concepts and processes. Moreover, this modern trend in employing modern strategies in the educational process and investing them in developing higher scientific and intellectual skills and acquiring scientific concepts among students. The problem of the study is represented in the urgent need to improve the methods and strategies currently used in teaching university students to raise the level of their understanding of scientific concepts and their acquisition of primary and integrated science operations skills. Accordingly, the study problem was determined by the following two null hypotheses:

1. There are no statistically significant differences at the significance level ($\alpha = 0.05$) in the arithmetic averages of the grade-teacher students' scores on the development of biological concepts test for the experimental and control groups due to the teaching strategy (scientific and regular stations).

2. There are no statistically significant differences at the level of significance ($\alpha = 0.05$) in the arithmetic averages of the grade-teacher students' scores on the scale of science operations skills for the experimental and control groups due to the teaching strategy (scientific and regular stations).

Study Importance

The importance of the study was represented in three aspects: Theoretically, Practically, and research, as follows:

- Theoretically, it deals with a modern teaching strategy in response to what is advocated by modern trends in science education and science teaching.

- Practically: The study provides a guide that includes descriptive and applied procedures for the strategy of scientific stations that may provide faculty members with opportunities to employ and activate this strategy. The study also provides a measure of science process skills and a test of biological concepts, which may help researchers in similar studies.

- Research: to be a starting point and generate more research and studies in this field and other scientific fields.

Study Limits and Limitations

The study was implemented and applied in light of the following limits and limitations:

- The study was limited to an intentional sample of classroom teacher students enrolled in the subject of life and health sciences at the Faculty of Educational Sciences at Al-Isra University in the first semester of the academic year 2021/2022.

- The credibility of the two study tools, the Biological Concepts Test and the Science Operations Skills Scale, determines the study's results.

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Study Objective

The current study aimed to reveal the effect of using the scientific station's strategy in developing biological concepts and acquiring science operations skills for female class teacher students at Al-Isra University.

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Study Terms and Procedural Definitions

Scientific station strategy: It is a teaching strategy in which students move in small groups through a series of stations, allowing them to perform all the different activities by alternating between the stations. Stations can support teaching abstract concepts and concepts that need a large amount of repetition, and stations can cover one concept or several concepts. (Jones, 2007, 16). It is defined procedurally as a teaching strategy represented by a group of stations that the students pass through and practice the educational activities in each of them, which may be investigative, exploratory, visual, or electronic .... and others this allows them to work in small groups (4-6), to develop skills in science operations and acquire biological concepts.

Usual method: This method is based on the principle of direct indoctrination, explanation, and theoretical presentation of the scientific material by the teacher using the blackboard and chalk. The role of the student is limited to listening and memorizing (Alyan, 2010).

Biological concepts are those contained in the unit of living organisms in the life and health sciences.

Developing biological concepts: Students can interpret and predict biological phenomena using scientific knowledge. This is known procedurally as the mark the student obtains in the test specially prepared for.

Science Operations Skills are the set of special mental abilities and processes practiced to reach scientific results and verify the results' validity (Alyan, 2010). Moreover, they are defined procedurally by the mark the student obtains in the scale specially prepared for that.

Methodology

Study Personnel

The study was limited to a sample of 61 class teacher students registered in the subject of life and health sciences. The students were randomly distributed into two divisions: the experimental group (30), who studied using the scientific station's strategy, and the control group (31), who studied using the usual method.

Study Tools

First: Biological Concepts Development Test:

The researcher prepared a test consisting of 25 items of the type of multiple choice. The validity of the test was verified by presenting it to specialized arbitrators, and the stability of the test was also verified by the test method by re-applying the test after two weeks on a group of 25 students outside the study sample. Then, the Pearson correlation coefficient was calculated and amounted to (0.85).

Second: Science Operations Skills Scale

The researcher prepared the Science Operations Skills Scale, consisting of 20 multiple-choice items. The scale was presented to a group of specialized arbitrators to determine the clarity and accuracy of the paragraphs from a scientific and linguistic point of view and the appropriateness of the items to the level of students. The reliability of the test was verified by applying the test to a sample outside the study sample using the test and retest method, according to the correlation coefficient, which was 0.88.

Difficulty and Discrimination Coefficients for Test Items

The percentages were adopted to find the coefficients of difficulty and discrimination for the items of the test of biological concepts, where the coefficients of difficulty ranged between (0.39 - 0.79) and the coefficients of discrimination ranged between (0.25 - 0.52). Thus, all items are considered to be within the

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acceptable range. As for the coefficients of difficulty and discrimination for the items of the Science Operations Scale, the coefficients of difficulty ranged between (0.27 - 0.74) and the coefficients of discrimination ranged between (0.23-0.51). All items are considered within the acceptable range.

Scientific Material

The unit of living organisms was selected from the subject of life and health sciences for class teacher students. It was presented to a group of specialists to ensure its suitability for the purpose for which it was prepared. A guide was prepared that included plans for teaching the unit according to the strategy of scientific stations.

Study Procedures

- Obtain official approval for the study application at the Faculty of Educational Sciences at Al-Isra University.

- Choose educational material from the subject of life and health sciences and prepare a guide for teaching it using scientific stations.

- Apply the study tools to the two groups (experimental and control) before and after treatment.

- Statistical analysis of the answers of the two study groups and the extraction and discussion of the results.

Study Design

The current study used a quasi-experimental design to investigate the effect of teaching strategies (educational stations, the usual method). It applied the strategy of scientific stations to the experimental group, the usual method to the control group, and the Biological Concepts Development Test and the Science Process Skills Scale before and after the experimental treatment.

Statistical Analysis

This study is considered a quasi-experimental study. In its design, the independent and dependent variables were identified as follows: Independent variables: Teaching strategy has two levels:

The strategy of the educational stations 2- The standard method.

Dependent variables: The current study has two variables: 1- Development of biological concepts and 2- Acquisition of science operations skills.

For the study, the arithmetic averages and standard deviations of the students' scores were used to test the development of biological concepts and the acquisition of science operations skills. ANCOVA was used to test the differences between groups to find out the effect of using the educational station's strategy in developing biological concepts and acquiring science operations skills in teaching the unity of living organisms in life and health sciences among class teacher students at Al-Isra University.

Study Results

First: Presenting the results related to the first study hypothesis, which states that There are no statistically significant differences at the significance level ($\alpha = 0.05$) in the arithmetic averages of the female students' marks in the test of developing biological concepts for the experimental and control groups due to the teaching strategy (scientific stations, regular). To test the first hypothesis, the arithmetic averages and standard deviations of the scores of the students of the study members were calculated on the test of

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developing biological concepts, pre, and post, according to the variable of teaching strategy, and Table (1) shows that:

Table 1: Arithmetic Averages and Standard Deviations of the Female Students' Scores on the Pre and Post-Biological Concepts Test

Group	Pretest			Posttest		
	Number	Arithmetic average	Standard deviation	Number	Arithmetic average	Standard deviation
Experimental	30	8.167	2.65	30	16.97	1.67
control	31	7.87	2.43	31	9.84	2.25
Total	61	8.02	2.53	61	13.34	4.10

Table (1) notices apparent differences between the arithmetic averages of the marks of the female students in the experimental and control groups on the pre-and posttests of developing biological concepts. To test the significance of these differences, one-way analysis of variance (ANCOVA) was used for the scores of female students on the posttest of developing biological concepts, and Table (2) shows this.

Table 2: Results of the Analysis of Variance Associated with the Posttest Concepts Test

Contrast source	Sum of squares	Degrees of Freedom	Squares averages	F value	Statistical significance	Partial Eta Squared
pretest	.006	1	.006	.002	.969	0.00
Teaching method	771.66	1	771.66	191.960	0.000	.77
The error	233.154	58	4.020			
Total	1007.77	60				

The results of Table (2) show that there is a statistically significant effect at the level ($\alpha = 0.05$) for the variable of teaching strategy, where the value of P is (191.960); this value is statistically significant, meaning that there is a statistically significant difference in the development of biological concepts test, and in order to find out which of the two methods the differences are attributed, the adjusted arithmetic averages of the scores of the students of the study members were calculated on the posttest biological concepts. Table (3) shows these adjusted averages.

Table 3: The Modified Arithmetic Averages of the Scores of the Female Students in the Study on the Post-Posttest

	Number of people	Modified arithmetic average	Standard Error
Experimental	30	16.966	.366
control	31	9.839	.360

Table (3) shows that the arithmetic average of the scores of the experimental group students was 16,966, while the arithmetic average of the scores of the students of the control group was 9.839; this means that the strategy of the scientific stations has a practical impact on the development of biological concepts for the benefit of the experimental group. The effect size was also found using the Eta square, as shown in Table (2), where it was found to be equal to (.768); this means that the teaching strategy explains about (77%) of the variation in the development of biological concepts among the female students of the study members. In comparison, the rest (23%) is not explained due to other factors that may not be controlled. Thus, the first null hypothesis is rejected, and the alternative hypothesis is accepted.

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Second: Presenting the results related to the second study hypothesis, which states:

- There are no statistically significant differences at the significance level (α = 0.05) in the arithmetic averages of the female students' marks in acquiring science operations skills for the experimental and control groups due to the teaching strategy (scientific and regular stations). To test the second hypothesis of the study, the arithmetic averages and standard deviations of the scores of the female students of the study members were calculated on the pre and post-science operations skills scale according to the variable of teaching strategy and Table (4) shows that:

Table 4: The Arithmetic Averages of the Female Students' Scores on the Pre and Post-Science Operations Skills Scale

Group	Pretest			PosttePosttest		
	er	Arithmetic average	standard deviation	Number	Arithmetic average	standard deviation
Experimental	30	7.43	2.75	30	15.77	1.96
Control	31	7.03	2.04	31	9.87	2.54
Total	61	7.23	2.40	61	12.77	3.73

It is noticed from Table (4) that there are apparent differences between the arithmetic averages of the marks of the female students for the two experimental and control groups on the scale of skills processes of pre and post-science to test the significance of these differences, one-way analysis of variance (ANCOVA) was used for the scores of the female students of the study members on the post-science process skills scale, and Table (5) illustrates this.

Table 5. Results of the Analysis of the Variance Associated with the Scores of the Female Students on The Post-Science Operations Skills Scale

Contrast source	sum of squares	degrees of freedom	squares average	F value	Statistical significance	Partial Eta Squared
pretest	.002	1	.002	000	.984	.000
Teaching method	526.363	1	526.363	100.145	0.000	.633
error	304.848	58	5.256			
total	834.787	60				

The results of Table (5) show that there is a statistically significant effect at the level (α = 0.05) for the variable science operations skills, where the value of F is equal to (100.145). This value is statistically significant, meaning a statistically significant difference exists on the science operations skills scale. In order to find out to which of the two methods the differences are attributed, the arithmetic averages adjusted for the scores of the students of the study members on the scale of post-science operations were calculated in Table (6).

Table 6. Modified Arithmetic Averages of the Scores on the Dimensional Science Operations Skills Scale

Group	Number of people	Modified arithmetic average	Standard error
Experimental	30	15.767	.42
Control	31	9.870	.41

Table (6) shows that the arithmetic average of the marks of the experimental group students was (15.767), while the arithmetic average of the marks of the students of the control group was (9.870). This means that the strategy of the scientific stations has a practical effect on acquiring the science operations skills of the experimental group's students. The effect size was also found using the Eta square, as shown in Table (5), where it was found to be equal to (.768); this means that the teaching strategy explains about (63%) of the variation in the acquisition of science operations skills among female students of the study members. In comparison, the rest (37%) is not explained due to other factors that may not be controlled. Thus, the second null hypothesis is rejected, and the alternative hypothesis is accepted.

Results Discussion

In the previous sections, the literature reviewed gives a clear view of the ethical, clinical, and decision-making concerns regarding mosaic embryo transfer. Nevertheless, many knowledge gaps still exist: competencies of health professionals, training and decision-support resources, and cultural differences in practice. To fill these gaps, our study will focus on the self-rated competencies, decision-making, and ethical dilemmas that health professionals experience when dealing with mosaic embryos. Research into these underdeveloped areas will offer significant practical implications for enhancing clinical recommendations, practitioner education, and informative resources for clinicians participating in mosaic embryo transfer.

Increase in Biological Concepts scores: The experimental group's performance on Biological Concepts also improved from a pretest mean of 8.17 to a posttest of 16.97. This sharp improvement indicates that the active, hands-on, and inquiry-based engagement and interaction promoted by the Science Stations Strategy enhances a deeper understanding of biological concepts. The control group, which used the traditional approach of teaching, only had a marginal rise in the scores for the posttest concept, with a mean of 7.87 and a mean of 9.84. These findings align with several research studies in science education that show that active and student engagement techniques lead to better student understanding of the concepts than the conventional teacher-centered approach of lecturing (Al-Zahrani, 2018; Ambosaidi & Al-Balushi, 2018).

Time and again, studies have underlined the drawbacks of conventional methods of transmission, which load the educator with most of the responsibility of knowledge dissemination and merely involve students as receivers of that information (Gercek & Ozen, 2016). On the other hand, the Science Stations Strategy, which mandates the students to move from one learning center to the other, allows exploration, experimentation, and group work. This relates to the constructivism theory, pointing to the fact that students need to build their understanding through feelings, manipulation, and reflections. With increased engagement, the understanding of the concepts is enhanced. Since the students were exposed to practical use of the concepts, this accounted for the much higher mean scores of the experimental group.

The results on acquiring science operations skills were highly favorable for the experimental group, with a mean gain of 8.34 and a start score of 7.43 and 15.77. The improvement in this graph suggests that the students who were put under the Science Stations Strategy learned their Science Operations skills more than those in the control group, who only had a raise from 7.03 to 9.87. These findings align with those of Greco et al. (2015), who stated that competency improvement is work when it involves inquiry-based learning, which is usually characterized by actively engaging with scientific procedures. The Science Stations Strategy has helped the students because the practical involvement in this strategy has enhanced their handling of scientific experiments, methodologies, and tools.

The Substance of the Science Stations Strategy enables learners to enact science operations skills in proper contexts, promoting active learning and deep thinking. During their work in stations, students complete different scientific activities involving concepts, problems, and decision-making. This is very similar to how research is conducted in the real world, and it entails such values as adaptability, thinking, and working with many-sided tasks. The opportunities for active participation in scientific practices are important for building science operation skills needed for future science teachers and scientists (Maykhan, 2019).

Comparison with Previous Studies The findings of this study are in tandem with the previous studies advocating for the adoption of inquiry and student-centered approaches to the teaching and learning of science. Ambosaidi and Al-Balushi (2018) discovered that such strategies improve critical thinking skills and conceptual development, which are incongruent with the current studies wherein the Science Stations Strategy has been identified to have effectively improved conceptual knowledge and scientific skills. Gercek and Ozen (2016) also focused on the importance of active learning in science classrooms; active learning means that students are occupied with something or are solving a problem, and students' engagement is higher when they are in practice. In the same way, Al-zahrani (2018) found an increase in students' skills and knowledge in enacted inquiry learning environments. This finding is reflected in the current study, too.

However, the outcomes differ from some works showing that applying the IBS did not always bring about a marked increase. For instance, Twizeyimana et al. (2024) observed that while the inquiry-based learning strategies increased student engagement, the overall enhancement of the student's conceptual understanding varied from one educational environment to the other. As Cortes et al. (2024) also pointed out, there was evidence that inquiry-based programs enhanced research skills. However, the positive results were less evident in learning outcomes among students where teachers did not have maximal training in the methodology. The possibility of such differences in outcomes could be attributed to the length of the program, the level of student engagement, or the type of content taught. On the other hand, the current study, which involves a four-year structured professional development of teachers, points towards a more profound enhancement of biological understanding and operational principles of science.

Possible Sources of Influence The following factors contributed to the positive results of the experimental group. First, the long period of the program (four years) may be explained by increased learning and knowledge accumulation. The shorter programs fail to allow the teachers enough time to implement the strategies. In contrast, the more extended program is more time-consuming, enabling the skills and concepts being taught to be developed over a long period. Another aspect is the focus on mentorship; teachers were provided with such throughout the year, although it is unclear whether they could appropriately use the Science Stations Strategy in the classroom. The feedback provided during the learning program helped the teachers make changes to their practice and achieve a closer match with the objectives of this learning strategy.

Furthermore, the positive impact of the Science Stations Strategy in the experimental group can be associated with the collaboration aspect of the intervention. Thanks to interaction with their colleagues at different stations, children discuss and solve problems together, thus making the key concepts of biology and research methods clearer. This type of peer interaction is usually not characteristic of traditional teaching circumstances in which a learner is likely to study alone.

Implications for practice Therefore, the present study's findings suggest that the Science Stations Strategy is valuable for promoting science literacy, especially for the growth of biological understandings and science operations knowledge. The findings are underpinned by the fact that students should be allowed to be as physically involved as possible with the course content. Professional teacher development programs should embrace the Science Stations Strategy and other inquiry-based teaching strategies to help students develop deeper meaning and skills. The current study also emphasizes the importance of follow-up and coaching for teachers so that they may continue to use these strategies in their practice.

Conclusion

Thus, the present research results contribute to developing the line of studies that promotes the inclusion of active learning approaches into the teaching and learning science process. This paper has also demonstrated that the Science Stations Strategy is a suitable methodology for enhancing biological content knowledge and science functioning knowledge. The improvement noted in the experimental group indicates that purposeful, discovery-driven pedagogy, augmented with support from subject-specialist coaches and feedback, may increase science-learning performance. Thus, this research provides valuable information for understanding how well the Science Stations Strategy works and whether it can become a means for change in science education for universities.

References

Al-Ankabi, Wafaa (2014). The effect of teaching using the scientific station's strategy on fifth-grade female students' achievement and retention in the general science subject. Journal of the College of the Basic Education / University of Babylon, Volume 15.

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Al-Ayasrah, A. H. ., & Abumuhfouz, O. A. E. . . (2023). Scientific Stations Strategy Knowledge Level and its Relationship to Teaching Practice among Basic Stage Science Teachers in Mafraq Governorate. Dirasat: Educational Sciences, 50(2), 345–356. https://doi.org/10.35516/edu.v50i2.397

Al-Farkahi, Mustafa, and Al-Abaji, Amal (2019). The effect of the scientific station's strategy in modifying the misunderstanding of scientific concepts among first-grade intermediate students in a science subject. Research Journal of the College of Basic Education, 15(4), 709–734.

Al-Hafidh, H. M. S. (2020). Effect of Using Scientific Stations Strategy in Developing Deductive Thinking of Intermediate School Students in General Sciences. International Journal of Early Childhood Special Education, 12(2), 35–48. https://doi.org/10.9756/int-jecse/v12i2.201054

Al-Lhaibi, Abdul Razzaq (2015). The effect of using the scientific station's strategy on the achievement of the second intermediate grade students and their attitude towards physics. Al-Fath Magazine, 11 (62). 202-236.

Al-Tuwaiji, A. (2018). The impact of teaching practical physics by the strategy of scientific stations and its impact on the development of integrative science processes among first-level students at Community College, Aden Governorate, Journal of Educational Sciences and Human Studies, Issue (3). 165-190.

Al-Zahrani, Azza (2018). The effect of the strategy of scientific stations on achievement and some science operations in science for sixth-grade female students in the city of Makkah Al-Mukarramah. Journal of Educational and Psychological Sciences Issue 16 Volume 2 Pages 145-167.

Ambosaidi, Abdullah and Al-Balushi, Suleiman. (2018). Science Teaching Methods (Concepts and Practical Applications), (I 4). Amman: Dar Al Masira is responsible for publishing, distribution, and printing.

Boschen, J. (2018). 4 Tips for Successful Elementary Science Stations. Retrieved November 13، 2019, from https://www.whatihavelearnedteaching.com/4-tips-for-successfulelementarysciencestations.

Boutros, Hafez Boutros (2014). Developing scientific concepts and skills for pre-school children, Amman: Dar Al Masirah for Publishing and Distribution.

Bulunuz,N., Jarrett, o. (2010). The Effects of Hands-on Learning Stations on Building American Elementary Teachers' Understanding About Earth and Space Science Concepts, Eurasia Journal of Mathematics, Science & Technology Education, vol. 6(2), 85-99

Chambers. D. (2013), Station learning: Does It Clarify Misconceptions on Climate Change and Increase Academic Achievement through Motivation in Science Education? Unpublished Master's Thesis, Ohio University, USA, [2] Cohen

Cortes, S. T., Lorca, A. S., Pineda, H. A., Tubog, R., & Vilbar, A. (2024). Strengthening science education in basic education through a professional development program on participatory action research for science teachers. Social Sciences & Humanities Open, 10, 101194. https://doi.org/10.1016/j.ssaho.2024.101194

Daoud, Tarek Kamel (2016). The impact of the strategy of scientific stations on the achievement and habits of mind of the fourth scientific students in biology. Journal of Educational and Psychological Research: the University of Baghdad, No. 50, 291-318.

Gercek C., Özen, O. (2016). Determine the students' views towards the learning stations developed for environmental education. Problems of education in the 21st century, 69(1), 29-36.

Ibrahim, Marwa Madi Ahmed (2021). The effectiveness of an enrichment program using scientific stations in developing scientific inquiry skills for preparatory stage students. Research Journal. 1 (2). 126-152.

Jones, D. (2007). The station Approach: How to teach with limited Resources, Science Scope,21–61.

Khataiba, Abdullah (2011). Teaching Science for All, (3rd Edition). Amman: Dar Al-Masirah is responsible for publishing, distribution, and printing.

Maykhan, Haifa Adnan (2019). Using the scientific station's strategy affects the achievement of first-grade intermediate students in science and high-ranking thinking. Journal of the College of Basic Education, 25 (103). 662-703.

Momani, Rabea (2018). The impact of some educational quality standards on student satisfaction at Zarqa Private University in Jordan, Journal of Educational and Psychological Sciences, No. 22 (2).

Mustafa, M. (2014). The importance of scientific concepts in science teaching and learning difficulties, Journal of Social Studies and Research, El Wadi University, (8), 88–108.

Nazareth, Omar. Karasneh, Sameeh (2020). The effect of employing the "smart" learning station strategy on students' achievement in the history course. International Journal of Educational and Psychological Studies, 7, (2) - pp.: 303–319.

Qeshta, Z. (2018). The effect of employing the strategies of scientific stations and educational games in developing creative thinking skills in science for seventh-grade students in Gaza, [Unpublished master's thesis], College of Education, Islamic University, Gaza, Palestine.

Rogayan, D. (2019). Biology Learning Station Strategy (BLISS): Its Effects on ScienceAchievement and Attitude towards Biology. International Journal on Social and Education Science, Volume 1, Issue 2, 2019 ISSN: 2688–7061 (Online).

Suleiman, Tahani (2015). A proposed program of activities based on scientific stations to provide kindergarten children with some scientific concepts and science processes. The Egyptian Journal of Scientific Education: The Egyptian Society for Scientific Education, 1. (2) 1. 23-

Twizeyimana, E., Shyiramunda, T., Dufitumukiza, B., & et al. (2024). Teaching and learning science as inquiry: An outlook of teachers in science education. SN Social Sciences, 4, 40. https://doi.org/10.1007/s43545-024-00846-4

Vosniadou,S.(2019).The Development of Students' Understanding of Science. Front. Educ. 4:32. doi: 10.3389/feduc.2019.00032

Zeitoun, Ayesh Mahmoud (2011). Methods of teaching science, Amman: Dar Al-Shorouk for Publishing and Distribution.