The Effect of the Needham and Cosgrove - Osborne Model on Acquiring the Concepts of the Fundamentals of Education among Students of the College of Education

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Abstracts

The research seeks to ascertain the influence of the Needham and Cosgrove-Osborne models on the comprehension of educational foundations among students at the Faculty of Education. Employing a partially controlled experimental design, the researcher randomly selected a control group from Division C, with Division A representing the first experimental group and Division B the second. The study involved 92 participants, with 30 students in each experimental group and 32 in the control group. To ensure statistical equivalence among the three groups, the researcher utilized one-way analysis of variance (ANOVA) to assess variables such as chronological age (in months), intelligence test results, and the previous year's Grade Point Average (GPA). A test was crafted to evaluate concept acquisition, with its validity and reliability duly established. Upon statistical analysis of the students' responses using ANOVA and the Scheffe test to pinpoint differences in means, the findings revealed significant disparities between the average scores of students in the first and second experimental groups, who studied the subject matter using the Needham, Cosgrove, or Osborne models. The researcher posits that the Needham and Cosgrove-Osborne models should be integrated into teaching practices, given their demonstrated effectiveness as instructional paradigms.

Keywords: Needham model, Cosgrove-Osborne model, acquiring concepts, and foundations of education.

Introduction

Despite the progress made in the field of teaching methods, education in universities is still in urgent need of development through the search for modern educational methods, models, and strategies that may have a tangible impact on achieving important educational goals. Among these goals is fostering students' thinking skills, a crucial objective that education strives to achieve. One of these models is the Needham model, a constructivist theoretical model aimed at providing students with new knowledge and assisting them in integrating new facts and experiences with subsequent experiences to aid in information retrieval (Mahmoud, 2020: 1054).

This teaching model helps ensure that the learned information and experiences are meaningful within the learner's cognitive structure. Under this model, the learner actively interprets phenomena or situations to construct meaning for new information or experiences, thereby initially acquiring or learning concepts (Amir, 2017: 163). The importance of Needham's model lies in its ability to help students link new knowledge to their existing knowledge structure and experiences. This connection aids in the easy retrieval and recall of facts and knowledge, allowing students to retain them for as long as possible (Abu Shama, 2017: 108). This model helps learners to form new knowledge and allows them to develop skills such as problem-solving, prediction, and other higher-order thinking skills, which are the goals they seek to achieve (Abdul and Hussein, 2020: 343). As for the Cosgrove-Osborne model, it is another modern model rooted in constructivist learning, emphasizing the importance of finding solutions to problems and experiences relevant to the students' real-life contexts. This model explains the relationships between the learner and the information that is understood, describing how the learner links new information with existing knowledge. It encourages educational activities to be learner-centered, where students are involved, active participants rather than passive recipients in the learning process.

The significance of this model is that it enhances the role of learners in the classroom, making them the focal point of the teaching process. It allows for discussion and dialogue with peers, promoting active learning. Additionally, it emphasizes communication skills, fostering relationships among students, and advocates for meaningful learning (Muhammad, 2014: 41). Many students face difficulties in understanding the new and complex concepts included in the college curriculum. There are also notable deficiencies in the traditional teaching methods used for this subject, which often focus solely on the cognitive aspect without addressing teaching concepts and developing thinking patterns — a benefit achieved through modern methods and models. This issue extends beyond university stages and has roots in earlier educational phases, causing students to develop an aversion to the subject (Al-Fartousi, 2015: 8). The current research aims to identify appropriate models that can be used in teaching the foundations of education and to achieve the objectives of this subject using the Needham and Cosgrove-Osborne models. These models may contribute to the advancement of this subject. The research problem is encapsulated in the following question: Firstly, Does Needham's model have an impact on the acquisition of the concepts of the subject of the foundations of education among the students of the Faculty of Education? Secondly, Does the Cosgrove-Osborne model have an impact on the acquisition of the concepts of the foundations of education among students of the Faculty of Education?

The goal of Habib's 2020 study was to evaluate how well the Needham and Good & Lavioe models integrated teaching strategies and improved students' capacity for analytical thought at the Faculty of Islamic Sciences. Three groups of 35 students each—a first experimental group, a second experimental group, and a control group—made up the study sample of 105 students. A partially controlled experimental design was employed by the researcher. For the study, an analytical thinking test and an achievement test for instructional strategies were created. On factors such as age (in months), prior knowledge, IQ test results, pre-analytical thinking test scores, and the Shivie test, statistical analyses included one-way analysis of variance and the Chi-square test. The first and second experimental groups did better in terms of accomplishing

teaching approaches than the control group, which adhered to traditional teaching methods, according to the data. Furthermore, on the analytical thinking test, the first experimental group outperformed the second experimental group.

In Mehdi's 2022 study, the objective was to evaluate the effect of Needham's constructive model on improving historical thinking skills in fourth-grade literary students. The study sample included 50 students, evenly divided between an experimental group of 25 students who were taught using the Needham model and a control group of 25 students who received instruction through the traditional method. The researcher developed a test specifically focused on historical thinking skills for the study. A partially controlled experimental design was employed. To ensure the reliability and validity of the research tools, the researcher utilized the Pearson equation for internal consistency validation and the Cronbach's Alpha equation for tool consistency. Additionally, equations were used to calculate coefficients for difficulty, ease, and excellence to evaluate misconceptions. The findings of the study demonstrated that the experimental group, which was educated using the Needham model, achieved better results than the control group in the examination that measured historical thinking skills.

In Noah's 2021 study, the aim was to assess the effect of Cuskroff's model on the academic achievement of fifth preparatory grade students in biology and generative thinking. The study sample comprised 36 students, with 18 students in the experimental group and 18 students in the control group. A partially controlled experimental design was used for the study. The researcher developed achievement tests in biology and generative thinking as part of the study. Various statistical analyses were performed including T-tests for discrimination coefficients, difficulty coefficients, effectiveness of alternatives, and utilizing the Cooper equation. The study outcomes indicated that the experimental group surpassed the control group in both the biology material achievement test and the generative thinking test.

Hashem study (2022): In the study aimed to assess the impact of the Koskrov-Osbourne model on the academic performance in the subject of general teaching methods among students at the Institute of Fine Arts, a sample of 30 students participated, with 15 students in the experimental group and 15 students in the control group. The researcher developed an objective achievement test specifically for the subject of general teaching methods. The experimental method was employed in the study, with statistical analyses conducted using the T-test to assess discrimination coefficients, difficulty coefficients, and the effectiveness of incorrect alternatives. The study results indicated that the experimental group, which was taught using the Koskrov-Osbourne model, performed better than the control group in the test assessing the achievement of the subject of general teaching methods.

Research Methodology

This chapter delves into the methodological framework that underpinned the research, encompassing the selection of a suitable experimental design, the identification of the target research population, the approach to sampling, the establishment of group equivalence, the specification of research materials and instruments, the elucidation of their application, and the

description of the statistical techniques employed. The subsequent section will provide a comprehensive account of these methodological steps.

1.1. Experimental Design

The researcher chose the partially tuned experimental design and found it suitable for his research conditions.

1.1.1. Research community

The current research population is composed of students at the Iraqi University College of Education for the academic year 2023-2024, totaling 1,892 individuals, who are enrolled in the morning study program of the first stage.

1.1.2. Research sample

The Department of Educational and Psychological Sciences was chosen as the venue for the experiment. From this department, Division (A) was selected, which included a control group. The initial number of students was 93, but after excluding one student due to failure, the final sample size was reduced to 92 students. These students were divided into three groups: the first and second groups each had 30 students, while the control group consisted of 32 students.

1.1.3. Equity of the sample members

Before conducting the experiment, the researcher verified the equivalence of the three groups in the variables:

1) Chronological Age of Students Calculated in Months, Intelligence Variable, and Previous Year's Average.

2) The researcher collected data on the students' ages calculated in months using an information form designed for this purpose. The data were then analyzed statistically to determine the equivalence between the students in the research groups using a one-way analysis of variance (ANOVA). The assumptions of the test were confirmed by checking several conditions, including the sample size of the three groups and any differences between them, the homogeneity of the sample, and the normality of the frequency distribution for both groups. After confirming the normal distribution and homogeneity of the research sample, the researcher used ANOVA to determine the significance of the age differences among the research groups (the first and second experimental groups and the control group). The calculated F-value was 1.171, which is smaller than the table value of 3.1 (at the 0.05 significance level), indicating that there are no statistically significant differences in age among the groups. Table 2 illustrates these findings

3) Intelligence Test: The researcher utilized the standardized mental abilities test developed by Hemmon-Nelson, which has been applied to Iraqi university students. This test comprises 94 items, each with 5 possible answers, one of which is correct. The maximum score achievable is 94, while the minimum is 0. After administering the test and correcting the students' answers, the results were obtained. A one-way analysis of variance (ANOVA) was conducted, revealing that the calculated F-value was 1.421, which is less than the critical value of 3.1 (at the

0.05 significance level). This indicates that there are no statistically significant differences in intelligence among the research groups. Consequently, the research groups are considered equivalent in terms of the intelligence variable, as shown in Table 2.The average of the previous academic year 2022-2023: The researcher obtained academic achievement grades in the general average of the sixth preparatory grade for the academic year 2022-2023 from students and after using the single variance analysis, as the calculated value was (0,007), which is smaller than the table value (11,3)at the level of (0.05). The results showed no statistically significant differences between the research groups, and Table (1) shows this.

Table (1). Results of variance analysis according to age, intelligence and previous year's rate.

Age Parameter	Sample Individuals:	Average	Source of variance	Total Squares	df	Squares mean	Calculated value	Significance level
First Experimental	30	833	between groups	296	2	648	020	Not significant
Second Experimental Group	30	366	within groups	72398,008	89	461		
Control group	32	312	Total	Control group	32			
IQ Variant	Sample Individuals:	Average	Source of variance	Total Squares	df	Squares mean	Calculated value	Significance level
First Experimental	30	1000	between groups	328	2	164	1,421	Not significant
Second Experimental Group	30	366	within groups	542	89	085		
Control group	32	937	Total	Control group	32			
Prev. year	Sample Individuals:	Average	Source of variance	Total Squares	Degree of Freedom	Squares mean	Calculated value	Significance level
First Experimental	30	311	between groups	10,474	2	237	256	Not significant
Second Experimental Group	30	213	within groups	762	89	469		
Control group	32	558	Total	236	91			

1.1.4. Control of extraneous variables

The process of adjusting variables in experimental studies aims to remove any effect of any variable other than the independent variable because the dependent variable has been affected by factors other than the experimental factor, and this means adjusting other factors or variables

that may affect the result of the experiment and its dimensions, because adjusting them leads to accurate results.

1) Experimental Conditions and Accompanying Incidents: The research experiment did not encounter any circumstances that affected its progress. Therefore, it can be said that any potential impact was avoided.

2) Maturation Processes: Maturation refers to the biological and psychological development that may occur in the students participating in the experiment while it is being conducted. This development could potentially affect their responses.

3) Measuring Instrument: The researcher employed a standardized tool to assess the acquisition of concepts among the students in the research groups (both experimental and control groups).

4) Differences in the Selection of Sample Members: This variable was addressed through statistical equivalence procedures among the students in the research groups to ensure that any differences were accounted for.

5) Experimental Mortality: Experimental mortality is the result of students (the research sample) leaving or interrupting their participation during the experiment. In this research, the experiment was not affected by any students interrupting or abandoning their participation.

- The Impact of Experimental Procedures: To prevent certain experimental procedures from influencing the dependent variable, the researcher attempted to minimize the impact of this factor on the experiment's outcome.

- Ensuring the Confidentiality of the Research: The researcher maintained the confidentiality of the research in collaboration with the Department of Educational and Psychological Sciences and did not disclose the nature of the research to the students.

- Determining the Vocabulary of the Subject: The scientific terminology used was consistent across all research groups, including both experimental groups and the control group.

- Educational Resources: The researcher utilized standardized educational materials such as colored pens, a data projector, and a calculator.

- Teaching: The researcher studied the groups (the two experimental groups and the control group) during the period of application of the experiment to them.

- College Building: The experiment was conducted in classrooms that were similar in terms of lighting, seating, size, and number of students.

1.1.5. Research Requirements

1) Determining the Educational Material: The researcher identified the vocabulary of the subject to be studied during the experiment, which includes topics from the foundations of education curriculum to be taught to students at the Iraqi University College of Education for the academic year 2023/2024.

2) Behavioral Goals: Three behavioral goals were formulated for each concept, aligned with three levels (definition, excellence, application). With 40 concepts, this resulted in 120 behavioral goals for concept acquisition.

3) Preparing Teaching Plans: The researcher developed teaching plans for the research groups based on the content and behavioral objectives, preparing 29 teaching plans for each group.

4) Preparing the Research Tool: To achieve the objectives of the current research, a test was constructed to assess the acquisition of concepts in the foundations of education.

a) Testing the Acquisition of Concepts: The test was built according to a scale that measures three aspects of concept acquisition: defining the concept, distinguishing the concept, and applying the concept.

b) Formulation of Test Items: A test with three items per concept was prepared, totaling 75 test items across the three areas (definition, discrimination, application). Each correct answer was given one point, and zero points for incorrect answers.

c) Test Validity: To ensure the validity of the test, 75 items were reviewed by experts to confirm their suitability for the intended measurement level. A threshold of 80% agreement was set for item acceptance.

d) Test Instructions: Instructions were provided for answering the test, including the total number of items and the time allowed for completion.

e) First and Second Pilot Applications: The test was initially applied to an exploratory sample of 30 students to check its validity, answer time, and item clarity. A second pilot test was then conducted with a sample of 200 students from the Iraqi University and the University of Mustansiriya. After grading, scores were ranked, and the top and bottom 27% were selected for analysis, totaling 54 students.

f) Test Item Analysis:

- Item Difficulty Level: The difficulty coefficient for each item ranged from 0.31 to 0.65. According to Bloom, items with difficulty levels between 0.20 and 0.80 are considered good.
- Item Discrimination Power: Al-Kubaisi states that items with a discrimination power of 0.20 or more are good. The discrimination power of the items ranged from 0.33 to 0.55.
- Effectiveness of Wrong Alternatives: The effectiveness of wrong alternatives ranged from 0.5 to 0.15, indicating that they attracted more students from the lower group than the upper group.
- Reliability Coefficient: The Kuder-Richardson equation 20 was used to calculate the reliability coefficient, which was found to be 0.96, indicating good internal consistency.
- The Final Version of the Test: The final test consisted of 75 items, distributed across three processes (definition, discrimination, application), with 25 items per process.

1.1.6. Application of the Experiment

The experiment was conducted from Wednesday, 22/11/2023, to Thursday, 2/5/2024.

1.1.7. Statistical Treatments

The following methods were used: one-way analysis of variance (ANOVA), Chebyshev's coefficient, difficulty coefficient, and item discrimination.

Results

1.1. Acquiring the Concepts of the Foundations of Education

To verify the null hypothesis, which states that there is no statistically significant difference at the 0.05 significance level between the average scores of students in the first experimental group who studied the foundations of education using the Needham model, and the average scores of students in the second experimental group who studied the same subject using the Coskruff-Osborne model, and the average scores of the control group who studied the subject using traditional methods, the researcher administered a test to assess concept acquisition. After obtaining scores for all three research groups, the researcher used one-way analysis of variance (ANOVA) to test the significance of the differences between the groups. The results of this analysis are presented in Table 2.

Table (2). Results of mono-variance analysis of research groups in concept acquisition.

MASDAR Variance	Total Boxes	Score Freedom	Medium Boxes	Worthless value		Statistical significance at (0.05)
				Calculated	tabular	
between groups	721	2	604	563	3,11	Function
within groups	833	89	639			
Total	554	91	604			

Table 2 indicates that the calculated F-value of 8.563 exceeds the critical F-value of 3.11 at a significance level of 0.05 and with degrees of freedom (2, 89). This suggests that there are statistically significant differences among the average scores of the three study groups in the concept acquisition test. Based on this finding, the null hypothesis is rejected. To identify the specific differences between the group means and to determine the direction and statistical significance of these differences, the researcher will present the results related to the post-concept acquisition test in accordance with the study's hypotheses. The researcher utilized the Scheffé post-hoc test to examine the differences between the group means, determine their direction, and assess their statistical significance among the scores of the three research groups as follows:

a) Balancing between the first experimental group and the second experimental group

The first hypothesis stipulated that there is no statistically significant difference between the average scores of the students of the first experimental group who studied the subject of the foundations of education according to the steps of the Needham model and the average scores of

the students of the second experimental group who studied the subject according to the steps of the Koskrov-Osbourne model in acquiring concepts at the level of significance (0.05). It is clear from Table (3) that the arithmetic average of the scores of the students of the first experimental group amounted to (47.23) degrees, and the arithmetic average of the scores of the students of the second experimental group amounted to (41.53) degrees. When testing the significance of the differences between the average scores of these two groups, and to verify the validity of this hypothesis, the researcher used the Sheffe test for poster comparisons between the means and Table (3) shows this.

Table 3. Chevet's critical value and the observed difference between the mean scores of the students of the first experimental group and the second experimental group in the acquisition of concepts.

Group	Number of people Sample	average Mean	the difference between an advanced Intermediaries	Chevron value Al Harjah	Level of significance
First Experimental Group	30	47-23-140	5,7	2,89	2,89 A function in favor of the set First Experimental Group
Second Experimental Group	30	41-53			

Based on Table 3, it is evident that the difference is statistically significant. The critical value of Scheffé (2.89) is smaller than the observed difference of 5.7 degrees between the average scores of the first experimental group and the second experimental group at a significance level of 0.05. This indicates a significant difference between the two means. The first experimental group, which studied the material according to the Needham model, demonstrated higher average scores in concept acquisition compared to the second experimental group, which followed the Koskrov-Osbourne model.

b) Balancing Between the First Experimental Group and the Control Group:

The second hypothesis stated that there is no statistically significant difference between the average scores of the students in the first experimental group, who studied the foundations of education according to the Needham model, and the average scores of the students in the control group, who studied the same subject using the traditional method, in terms of concept acquisition at a significance level of 0.05. Table 4 shows that the arithmetic mean of the scores for the first experimental group was 47.23, while the arithmetic mean for the control group was 38.50. To test the significance of the differences between the average scores of these two groups, the researcher used the Scheffé test for post-hoc comparisons between the means. The results of this analysis are presented in Table 4.

Table (4). Chevier's critical value and the observed difference between the mean scores of the students of the first experimental group and the control group in the concept acquisition test.

Group	Number of sample members	Average	Difference between the two averages	Chevier's Critical Value	Significance level (0,05)
First Experimental Group	30	47-23-140	8.73	2,89	The first experimental group
Control group	32	38,50			

The results presented in Table 4 indicate that they are statistically significant. The critical Scheffé value of 2.89 is smaller than the observed difference of 8.73 degrees between the average scores of the first experimental group and the control group at a significance level of 0.05. This suggests a significant difference between the two means, with the first experimental group, which studied the foundations of education according to the Needham model, showing higher average scores in concept acquisition compared to the control group, which used the traditional method of instruction.

c) Balancing Between the Second Experimental Group and the Control Group:

The third null hypothesis stated that there is no statistically significant difference between the average scores of the students in the second experimental group, who studied the foundations of education according to the Coskruff-Osborne model, and the average scores of the students in the control group, who studied the same subject using the traditional method, in terms of concept acquisition at a significance level of 0.05. Table 5 shows that the arithmetic mean of the scores for the second experimental group was 41.53, while the arithmetic mean for the control group was 38.50. To test the significance of the differences between the average scores of these two groups, the researcher used the Scheffé test for post-hoc comparisons. The results indicated that the difference is statistically significant, as presented in Table 5.

Table (5). Chevier's critical value and the difference between the average scores of the students of the second experimental group and the control group in the concept acquisition test.

Group	Number of sample members	Average	Difference between the two averages	Chevier's Critical Value	Significance level (0,05)
Second Experimental Group	30	41.53	3.03	2,89	The second experimental group
Control group	32	38.50			

The results presented in Table 5 indicate that they are statistically significant. The critical Scheffé value of 2.89 is smaller than the observed difference of 3.03 degrees between the average scores of the second experimental group and the control group at a significance level of 0.05. This suggests a significant difference between the two means, with the second experimental group, which studied the foundations of education according to the Koskrov-Osborne model, showing higher average scores in concept acquisition compared to the control group, which used the traditional method of instruction.

Conclusions

The students in the first experimental group, who studied the foundations of education according to the Needham model, and the students in the second experimental group, who studied the same subject according to the Coskruff-Osborne model, both outperformed the control group, which studied the subject using traditional methods, on the concept acquisition test. The students in the second experimental group, who studied the foundations of education according to the Koskrov-Osborne model, outperformed the students in the control group, who used traditional methods, on the concept acquisition test. Considering the conclusions reached by the researcher, the following recommendations are made:

1) Educators should work on training teachers of the foundations of education to use modern models in teaching that are based on constructivist theory, such as the Needham and Coskruff-Osborne models. These models should be integrated into the teaching process.

2) Teachers should be encouraged to focus on students' thinking in general and flexible thinking in particular.

3) The authors of educational materials for the foundations of education should be encouraged to clearly define concepts in their content.

4) An investigation into the impact of the Needham and Coskruff-Osborne models on other variables such as attitudes and tendencies towards the subject of the foundations of education, as well as their effect on correcting misconceptions, retention, and motivation in the subject.

5) A study to determine the influence of the Needham and Coskruff models on other types of thinking, including critical thinking, deductive thinking, scientific thinking, vertical thinking, and other cognitive processes.

6) Research to assess the impact of the Needham and Coskruff-Osborne models at different school levels, including primary, intermediate, and secondary education.

WORKS CITED

Ibrahim, F. A. F. A. (2017). The effectiveness of using the generative learning model in modifying alternative perceptions about some historical concepts and developing the trend towards the subject among students of the first secondary grade. Journal of the Faculty of Education in Aswan, 14(89).

Abu Shama, M. R. (2017). The effectiveness of Needham's constructivist model in the development and achievement of reflective thinking skills and some dimensions of scientific sense among first secondary school students in physics. Egyptian Journal of Practical Education, 20(5).

Ismail, R. A. S. (2014). The impact of using the generative learning model in correcting alternative perceptions among students of the second cycle of basic education and developing their deductive thinking. Journal of Arab Studies in Education and Psychology (ASEP), 47(4).

Amir, A. A. (2017). The impact of the model (Ableton) and the systemic approach in the acquisition of grammatical concepts and the development of systemic thinking among students of the fourth scientific grade (Unpublished doctoral dissertation). Faculty of Education for Humanities, University of Basra.

Badr, R. N. M. (2018). The effectiveness of using Needham's constructive model in correcting misperceptions in biology and developing generative thinking skills among high school students. Journal of University Performance Development, 6(2).

Habib, N. A. (2020). The effectiveness of the model (Needham) and (Good & Lavioe) in obtaining teaching methods and developing analytical thinking among students of the Faculty of Islamic Sciences (Unpublished doctoral dissertation). Faculty of Education Ibn Al-Rushd, University of Baghdad.

Hamid, S. M. (2014). The effectiveness of the generative learning model in achieving fourth grade preparatory students in history. Diyala Magazine, (63).

Rashid, T. N. (2019). The impact of Koskarov's model on the development of metacognitive thinking among fifth-grade students literature. Tikrit Journal, 6(4).

Abdul, I. H., & Khader, H. A. (2020). The effectiveness of teaching with Needham's constructive model in reflective thinking among fourth grade scientific students. Journal of the College of Education for Girls for Human Sciences, (26).

Aggression, Z. S., & Dawood, A. I. (2016). Social constructivist theory and its applications in teaching. Debono Center for Thinking Education.

Aggression, L., & Saleh, R. (2020). The impact of using the generative learning model in the development of modern graduation skills among students of the Faculty of Sharia, University of Jordan. Al-Manara Magazine, 26(1).

Al-Fartousi, A. M. A. (2015). The impact of the model of Janneh and Klauszmaier in the acquisition of grammatical concepts and their retention at the request of the Arabic language divisions in the faculties of basic education (Unpublished doctoral dissertation). University of Basra.

Mohammed, A. H. (2021). The impact of the use of Needham's structural model on the achievement and mathematical bonding skills of second grade intermediate students. Al-Mustansiriya University, Journal of the Faculty of Education, (1).

Mohammed, H. H. W. (2014). The effectiveness of the generative learning model in the achievement of fourth grade preparatory students in the subject of history. Diyali Journal of the Faculty of Education for Human Sciences, (63).

Mahmoud, K. A. (2020). The use of Needham's structural model in teaching science to develop the depth of scientific knowledge and high-level thinking skills among middle school students. Educational Magazine, (76).

Mahdi, H. A. D. (2022). The impact of Needham's constructive model on the development of historical thinking skills among fourth-grade literary students. Journal of the Faculty of Islamic Sciences, 33(1).

Noah, N. K. A. (2021). The impact of the Koscroff's model on the achievement of the students of the fifth preparatory grade in the subject of biology and obstetric thinking (Unpublished master's thesis). Faculty of Education, Mustansiriya University.

Hashim, S. A. (2022). The impact of Koskarov-Osbourne model on the achievement of the subject of general teaching methods among students of the Institute of Fine Arts. Lark magazine, (3).

Lee, M. F., Yusff, S. N., & Tan, K. H. (2019). Needham model based instructional multimedia material for teaching digital logic gates. Journal of Technical Education and Training, 11(1), 54-62.

Shaari, A. S. (2018). Keberkesanan model konstruktivisme lima fasa Needham dalam pengajaran komsas bahasa Melayu. Jurnal Pendidikan Bahasa Melayu - Malay Language Education Journal, 2, 79.

Orbanic, N., Dimec, D., & Cencic, M. (2016). The effectiveness of a constructivist teaching model on students' understanding of photosynthesis. Journal of Baltic Science Education, 15(5), 575-587.