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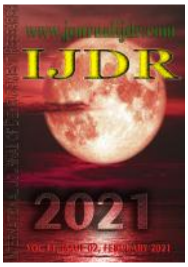

RESEARCH ARTICLE | OPEN ACCESS

THE APPLICATION OF DAVID A. KOLB'S EXPERIENTIAL LEARNING MODEL TO TEACH THE SCIENCE SUBJECT IN PRIMARY SCHOOLS FOR STUDENTS' COMPETENCY DEVELOPMENT: RESULTS FROM A PEDAGOGICAL EXPERIMENTAL STUDY IN HO CHI MINH CITY, VIETNAM

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ABSTRACT

Organizing experiential activities and developing students' competencies are the two main concerns in the renovation of the General Education Curriculum at the primary level. Particularly, experiential activities are the learning theory that lies at the heart of education with an orientation toward the development of students' competencies. They provide detailed guidelines to develop students' foundational experience toward the learning outcomes of the subject and the education level, thus, developing competencies. Applying Kolb's experiential learning model to teach the science subject in primary schools helps develop students' competencies. Using a pedagogical experimental approach, the article presents the results of administering a pedagogical treatment to clarify the relationship between applying a science teaching model adapted from Kolb's experiential learning model with the development of students' competencies in primary schools in Thu Duc District, Ho Chi Minh City, Vietnam. The findings contribute to promoting the renovation of the current primary education in Vietnam.

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INTRODUCTION

In the age of educational renovation where the body of scientific knowledge is growing rapidly, more and more educators have abandoned the conventional way of delivering knowledge. Instead, they teach learners the way to learn and help them form and develop the necessary competencies. As a result, organizing experiential activities with an orientation toward students' competency development has become a vital task, serving as the foundation for modern education. Responding to the new scenario in education, the General Education Curriculum (for primary level) issued under Circular 32/2018/TT-BGDDT by the Minister of Education and Training on December 26th, 2018 included many changes to the content and teaching methods (Ministry of Education and Training, 2018a). Among the new changes, experiential activities are receiving increasing attention because they allow students the opportunities to hone their strengths and improve their weaknesses. As students make use of their personal experience to participate in learning activities under the guidance of their teachers to learn about nature, society, and mankind, they also form and develop their competencies. Unfortunately, there remain certain inadequacies in the current teaching of the science subject. Teachers often use the conventional method where they deliver the lectures while the students listen and memorize the lessons. The teaching practice places the emphasis on the content, failing to develop students' competencies effectively. The main types of lesson organizations include whole-class and individuals. There are not enough teaching facilities and equipment. Students learn mainly with textbooks. Therefore, many of them are not interested in learning the science subject and not able to develop necessary competencies as required. Experiential learning is an educational theory with a long history of development. It started with the ideas of teaching methodologies from Aristotle, Socrates, Confucius, and other philosophers. The foundation of experiential learning theory is that the subject of awareness having the most important role during the process of gaining knowledge (Hoang, 2015).

Experiential education considers students' learning progress as the center of learning activities. During their learning progress, students need to take initiative and discover knowledge on their own. By doing so, they are able to build up knowledge for themselves using their personal experiences and their interactions with their learning environments (Beard, 2010; Kolb, 2014; Peuse, 1989; Silberman, 2007; Vince & Reynolds, 2008).

According to David A. Kolb, experiential learning has five major characteristics (Kolb, 2014):

- Learning is best conceived as a process, not in terms of outcomes.
- Learning is a continuous process grounded in experiences.
- The process of learning requires resolving the resolution of conflicts between dialectically opposed modes of adaptation to the world.
- Learning is an holistic process of adaptation to the world.
- Learning involves transactions between the person and the environment.
- Learning is the process of creating knowledge.

Due to the effectiveness of experiential learning in developing students' competencies, other educators such as Minakshi Biswal (Biswal, 2015), Christian M. Itin (Itin, 1999), and H. Gene Peuse (Peuse, 1989) have applied this theory and developed their own models for experiential learning. In Vietnam, in recent years, many studies on experiential learning have been used in teaching to help develop students' competencies. Prominent publications include the teaching materials *Experiential education* for the BA Management program (Joint BA Program between the International Faculty, Hanoi National University and Keuka University, 2011), *Designing and organizing creative experiential activities in primary schools*(Vietnam's Ministry of Education and Training, 2017), the series *Experiential activities* which include five books in each pack for students from grade one to grade five (Hanoi Education Investment and Development JSC, 2019), and the two-part series *Guidelines for organizing experiential activities for primary schoolers*(Nguyen & Le, 2018). With this reality in mind, the authors recognized the importance of clarifying the relationship between applying the model to organize experiential activities adapted from David A. Kolb's experiential learning model with an orientation toward developing students' competencies. This is a vital task in order to improve the current teaching practices, enhance education quality, meeting the demands for the renovation of the 2018 General Education Curriculum in Vietnam.

RESEARCH METHODS

Conceptual research: This article analyzes and synthesizes international and local scientific studies, articles, and other publications related to the use of experiential activities to teach the science subject with an orientation toward the development of students' competencies. Based on the findings from conceptual research, the authors clarified the relationship between applying Kolb's experiential learning model to teach the science subject in primary schools and the development of students' competencies.

Pedagogical experimental research: In order to test the feasibility of putting the model into practice to develop students' competencies, the authors employed an experimental research design and statistics – the data were computed and analyzed using SPSS 20.0 (Statistical Package For The Social Sciences). Results are presented in the form of tables, figures, and charts to showcase the findings of the experiment.

Sample selection: The authors conducted this pedagogical experimental study in two fifth-grade classes in Thai Van Lung Primary School, Thu Duc District, Ho Chi Minh City. The study lasted 18 weeks (one semester). The study used the random sampling method to ensure the equal probability of the sample size and characteristics. In particular, the sample selection is illustrated in Table 1.

Table 1. Sample selection for testing the use of experiential activities to teach the science subject

Grade	Experimental Group	Control Group	Total
Grade 5	41	40	81

Experimental content: Based on the lesson schedule of the science subject for grade four at the time the experimental study was conducted in Thai Van Lung Primary School, Thu Duc District, the authors organized experiential activities to teach the science subject in primary schools based on David Kolb's experiential learning model in 36 periods. The topics included "Human and Health" and "Matters and Energy."

The experimental process consisted of three main steps:

Step 1: The experimental group and the control group received a pre-test to determine the current competency level of the participants using the competency questionnaire.
Step 2: Pedagogical treatment was delivered during the teaching of the science subject according to the experimental plan.
Step 3: Both groups received a post-test which was in the form of the competency questionnaire.

The experimental results were analyzed as follows:

Step 1: Cleaning and analyzing the data.
The data was cleaned and analyzed with statistics (using SPSS and Microsoft Excel)
Step 2: Concluding the effectiveness of the experimental study.

Methods of analysis

Qualitative analysis: The authors assessed the competency levels that participants (from both the experimental and control groups) achieved as they answered the questions on the competency questionnaire. Quantitative analysis: The authors assessed the results of the tasks in the competency questionnaire based on the students' competency criteria and converted them into scores. Each level was assigned a point on the integral scale. The results are presented in the form of score tables and frequency charts. In particular: The frequency chart and cumulative line chart were drawn from the respective score distribution tables. The score distribution charts were drawn for both the experimental and control groups to compare the percentages of each score range and evaluate the differences: The group whose cumulative line leans more toward the right side performed better. The distance between the two cumulative lines is the score differences between the two groups.

Parametric statistics: In order to provide an objective and accurate evaluation of the effectiveness of organizing experiential activities on primary school students' competency development, the authors combined several forms of evaluation such as interviews, observations as well as a formative assessment of participants' learning progress.

Mean:

$$\overline{x} = \frac{1}{n * 100\%}\sum_{i-1}^{n} x_i * f_i$$

Where:
x_i: Participants' test scores, thus, $0 \le x_i \le 30$.
$f(x_i)$: The frequency of the score x_i
n: the number of participants in the experimental group or the control group

Mean squared error:

$$m = \frac{s}{\sqrt{n}}$$

Variance:

$$S^2 = \frac{1}{n}\sum_{i-1}^{n}(x_i - \overline{x})^2 f_i$$

Data analysis: The data were analyzed using Excel and SPSS 20.0. Statistical analysis was conducted on two levels:

Level 1. Descriptive statistics

Descriptive statistics	Abbreviation
Minimum	Min
Maximum	Max
Mean	M
Standard Deviation	Sd
Correlation Coefficient	R_p

Level 2: Result comparison (Independent t-test)
Hypothesis testing (using Independent t-test)
Null hypothesis: H_0: $\mu_1 = \mu_2$
Alternative hypothesis: H_1: $\mu_1 \neq \mu_2$

The Sig value is calculated. If Sig ≥ 0.05, H_0 is accepted, which means there is no statistical significance in the evaluation of the experiential activity organization before and after the treatment at a 95% confidence interval. If Sig < 0.05, H_0 is rejected. H_1: $\mu_1 \neq \mu_2$ is accepted, which means there is a statistically significant difference in the evaluation of the experiential activity organization before and after the treatment at a 95% confidence interval.

RESULTS AND DISCUSSION

Experimental data analysis: *Results from the pre-test administered to the experimental group and the control group before delivering the pedagogical treatment*

Before delivering the pedagogical treatment, the authors administered a pre-test to measure the participants' (who were fifth-grade students) science competencies based on the pre-determined criteria. By doing so, the authors were able to choose two homogeneous groups with similar academic performances and science competencies to be the experimental group and the control group. Below is the analysis of participants' scores (See Table 2).

Table 2: Comparison of the pre-test scores from the experimental group (EG) and control group (CG) before the pedagogical treatment

	Sample size	Min	Max	Mean	Standard deviation	Mode
EG	41	9	23	14.878	3.387	10 and 17
CG	40	9	23	14.900	3.650	15

The statistics on competency scores of the two groups before treatment show that the frequency, minimum score, maximum score, mean score, standard deviation, mode, and the cumulative score lines of the two groups had some minor differences but those were not statistically significant. More specifically, the two cumulative score lines are very close and meet each other at many points. This suggests that the two groups were homogeneous. However, to get a more accurate view of their academic performances and gain a more solid scientific basis, the authors continued to measure the correlation coefficient at the level of significance α= 0.01 (see table 3).

Table 3. Results of pre-test scores from the experimental group and the control group

	Correlation coefficient R_p	Significance Sig. (2-tailed)	Level of significance (α)
EG CG	0.471	0.002	0.01

The correlation coefficient of the mean scores from the experimental group and the control group before treatment is 0.471 (R_p = 0.471), Sig = 0.002< 0.05 at the level of significance α = 0.01. This suggests a positive correlation. The two groups were homogeneous and suitable for the experimental study.

Results from the pedagogical experimental study: Before comparing the results between the experimental group and the control group, the authors analyzed the improvements in participants' competencies in each group after a semester with and without applying Kolb's experiential learning model. The detailed results are as follows:

Comparison of results from the experimental group before and after treatment: The competency measures of the experimental group before and after treatment show significant differences in the frequency, minimum score, maximum score, mean score, standard deviation, mode, and cumulative scores. Particularly, the minimum score, maximum score, mean score, and the mode were higher after treatment than before treatment. After treatment, the standard deviation value was lower, suggesting more even development in participants' competencies. More specifically, it is clear that there is a significant distance between the two cumulative score lines before and after treatment. After treatment, the experimental group cumulative score line moves upward and leans more toward the right side, suggesting that the cumulative scores after treatment were higher. The experimental group showed more improvements. There is a significant upward movement.

Table 4. Comparison of competency results of the experimental group before and after treatment

	n	Min	Max	Mean	Standard deviation	Mode
Before treatment	41	9	23	14.878	3.874	10 and 17
After treatment	41	14	26	19.268	3.233	19

To get a more accurate evaluation of the participants' learning quality in the science subject before and after treatment, the authors measured the correlation coefficient at the level of significance α= 0.01.

Table 5. Results of the experimental group's scores before and after treatment

	n	Correlation coefficient R_p	Significance Sig. (2-tailed)	Level of significance (α)
Before treatment After treatment	41	0.901	0.000	0.01

The correlation coefficient of the mean scores from the experimental group before and after treatment was 0.901 (R_p = 0.901), Sig = 0.000 < 0.05 at the level of significance α = 0.01. This suggests a positive correlation. After the treatment, there are significant improvements in the experimental group's learning quality. However, to examine the practicality of the model and the validity of the study as well as to prove that the results above are statistically significant and did not occur by random chances or the participants' natural development, the authors continued to measure the differences in the mean scores of the experimental group before and after treatment at the level of confidence 95%. The results were as follows (see Table 6):

Table 6: Examining the differences in mean scores of the experimental groups before and after treatment, α = 0.05

	Paired differences					t	df	Sig.(2-tailed)
	Mean	Std. deviation	Std. Error Mean	95% confidence interval of the difference				
				Lower	Upper			
Results of EG before and after treatment	-4.390	1.701	0.266	-4.927	-3.853	-16.525	40	0.000

Table 7. Comparison of two measures of the control group's competency results

	n	Min	Max	Mean	Standard deviation	Mode
First test	40	9	23	14.900	3.650	13 and 15
Second test	40	12	23	16.200	2.709	15

Table 8. Results of the control group's competency scores from two tests

	n	Correlation coefficient R_p	Significance Sig. (2-tailed)	Level of significance (α)
First test	40	0.946	0.000	0.01
Second test				

Table 9. Differences in mean scores of the control group from two separate tests without treatment, α =0,05

	Paired differences					t	df	Sig.(2-tailed)
	Mean	Std. deviation	Std. Error Mean	95% confidence interval of the difference				
				Lower	Upper			
Results from the first and second tests of the control group	-1.300	1.399	0.221	-1.748	-0.852	-5.874	39	0.01

Table 10. Comparison of competency scores of the experimental group (EG) after treatment and the results of the control group (CG)

	n	Min	Max	Mean	Standard deviation	Mode
EG	41	14	26	19.150	3.183	19
CG	40	12	23	16.200	2.709	15

Table 11. Examining the scores of the experimental group and the control group before and after treatment

	n	Correlation coefficient R_p	Significance Sig. (2-tailed)	Level of significance (α)
EG	41	0.395	0.000	0.001
CG	40			

Table 12. Examining the differences in mean scores of the experimental and control groups after treatment, α = 0,05

	Paired differences					t	df	Sig.(2-tailed)
	Mean	Std. deviation	Std. Error Mean	95% confidence interval of the difference				
				Lower	Upper			
Results of EG and CG after treatment	2.950	3.266	0.516	1.906	3.994	5.713	39	0.00

Before and after the treatment, the results have Sig= 0.00<0.05, suggesting a statistically significant difference in the evaluation of the organization of experiential activities with a 95% level of confidence. Based on the independent t-test and participants' competency scores before and after treatment, the authors have concluded that applying the science teaching model adapted from Kolb's experiential learning model was successful in developing students' competencies. In other words, there is a clear and valid relationship between applying Kolb's experiential learning model and students' competency development. The statistics on competency scores measured on two occasions of the control group show that the frequency, minimum score, maximum score, mean score, standard deviation, mode, and cumulative scores of the control group appear to improve, but the improvements were not significant. More specifically, a closer look at the cumulative score line chart (Figure 6) reveals a close distance between the two cumulative score lines with many overlapping points. In the second test, the control group's cumulative score was higher, suggesting a certain degree of improvement but the difference is not statistically different. A correlation coefficient test at the level of significance α= 0.01 yielded results as follows (See Table 8): The correlation coefficient value from examining the control group's competency scores from two separate tests is 0.964 (R_p = 0.946), with sig = 0.000 < 0.05 at α = 0.01. This suggests a positive correlation, which means the learning quality was improved. Next, the differences in mean scores of the control group were examined at the level of confidence 95%. The results are as follows (See Table 9): Examining the results from the first and second tests yields the value Sig= 0.01<0.05. This suggests a statistically significant difference in the evaluation of the organization of experiential activities with a 95% level of confidence. In other words, using the t-test to examine students' competency scores from two separate tests, the authors have concluded that employing conventional teaching methods and techniques was effective in developing students' competencies. However, the improvements were not as significant in comparison with applying Kolb's experiential learning model.

Comparison of the results from the experimental group after treatment and the results of the control group: The statistics on competency scores of the experimental group after treatment and the control group show that the frequency, minimum score, maximum score, mean score, and mode of the experimental group were higher than the control group. The standard deviation value of the experimental group was lower than the standard deviation value of the control group. This suggests that the experimental group's competencies were more evenly developed.

More specifically, there is a significant distance between the cumulative score lines of the two groups (See Figure 7). After the treatment, the experimental group cumulative score line moves upward and leans more toward the right side. In other words, after the treatment, the cumulative scores of the experimental group were higher. The experimental group showed more improvements. There is a significant difference in improvements. To get a more accurate evaluation of the participants' competency development in learning the science subject before and after treatment, the authors measured the correlation coefficient at the level of significance $\alpha = 0.01$. The correlation coefficient value from examining the mean scores before and after treatment of the experimental group and the control group is 0.395, with sig = 0.000 < 0.05 at $\alpha = 0.01$. This suggests a positive correlation. The experimental group's learning quality show more significant improvements after receiving the treatment in comparison with the control group. To examine the practicality of the model and the validity of the study as well as to prove that the results above are statistically significant and did not occur by random chances or the participants' natural development, the authors continued to measure the differences in the mean scores of the experimental group and the control group before and after treatment at the level of confidence 95%. The results were as follows (see Table 12): Examining the results before and after treatment yields the value Sig= 0.01<0.05, suggesting a statistically significant difference in the evaluation of the organization of experiential activities with a 95% level of confidence. The null hypothesis H_o is rejected. The alternative hypothesis H_1: $\mu_1 \neq \mu_2$ is accepted. There is a statistically significant difference in the results from organizing experiential activities. Using an independent t-test to examine the participants' competency scores before and after treatment, the authors have concluded that there is a clear and valid relationship between applying the science teaching model adapted from Kolb's experiential learning model with an orientation toward competency development for primary school students.

DISCUSSION

Before the pedagogical treatment, the science competencies of the experimental group and the control group were similar. During lessons, the teachers mainly used conventional teaching methods such as instruction, Q&A, and discussion within the classroom. The common types of lesson organization included whole-class and individuals. Because textbooks were the main teaching facilities, measurements of students' competency development (the awareness of natural science, ability to discover surrounding natural environments, ability to apply learned knowledge and skills) were quite low. Many students failed to achieve the competency standards and were not interested in learning the science subject. After the pedagogical treatment, thanks to applying the four-stage model to teach the science subject adapted from Kolb's experiential learning model, teachers were able to design and organize experiential activities. They were successful in choosing the teaching methods, facilities, and equipment suitable for the particular lessons and students' cognitive and psychological characteristics. As a result, students had many opportunities to participate in learning activities. Their senses were engaged as they complete level-appropriate learning tasks, thus, developing the competencies needed for the subject. The results from the 18-week experimental study suggest both the conventional approach and the science teaching model adapted from Kolb's experiential learning model could help students develop their competencies. However, applying Kolb's experiential learning model yielded more significant improvements in students' competencies. It is proved that there is a clear and valid relationship between applying the science teaching model adapted from Kolb's experiential learning model and the competency development of primary school students.

CONCLUSION

In recent years, the renovation of the teaching content and methods for many subjects in primary schools has been continuously implemented in Vietnam. Particularly, organizing experiential activities is considered one of the foundational changes to the current teaching practices in order to help students develop competencies. It is during the process of participating, experiencing, observing, smelling, and touching real objects that students can engage all their senses. This results in learning autonomy and an appreciation for the subject. Thanks to applying Kolb's experiential learning model, students had the opportunities to observe, participate, and experience with learning activities, all of which greatly contribute to their competency development. Therefore, it is clear that there is a clear and concrete relationship between applying Kolb's experiential learning model to teach science in primary schools and the development of students' competencies.

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