

The Effect of Hands-on-Activities in Biology on Student Performance and Attitude

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Abstract

It may be noticed that students' engagement increases when they are active in the lessons. When they are forced to sit and listen in classical ways, they lose their focusing and mostly using visual sources doesn't help them to concentrate the lesson. 9th grade biology curriculum is based on molecular level biology such as organic molecules, DNA, cell organelles and cellular transport, which are very difficult to envisage, interpret and make connections. Students generally complain about that biology is boring, there are too many things to memorize, or it is difficult to understand. This study was designed if doing hands-on-activities increases students' interests and achievement in biology. The hypothesis was if students do hands-on activities in the lessons, then they will be more successful and develop more positive attitudes toward biology than the students who don't do hands-on activities. Forty-five 9th grade students attending Hisar School were participated in this study. A pre/post test design measured student performance of biology concepts about the cell. The experiment group with twenty-three 9th grade students who were taught using hands-on-activities. The control group with twenty-two students was taught the same topic without using hands-on-activities. The results indicated that there was no significant difference between the change in the biology scores of the students. On the other hand, there was a significant difference between the change in the scores of female students in the favor of experiment group. Male students' scores didn't show any significant difference. In order to explore attitude effect, 10 item- five scale pre/post Likert Scale was used. It was shown that there is a significant difference between biology attitude in favor of experiment group.

Keywords: Hands-on activities, biology, attitude

1. Introduction

21st century learners have distinct characteristic; they like doing group works, create products and using technology which may be all provided by hands-on activities, a teaching strategy in which students usually work in groups and interact with peers to work with several objects [9]. Activity based programs provide students better learning opportunities. It has been claimed that learning by active involvement of students may increase their learning[3]. Hands-on activities include experiments, observations, designing models and games that allow students being active in the class. They improve the mind by linking the brain and the hand[2]. The information gathered through the memories gained by auditory, visual, tactile and motor functions would be more powerful and retrievable. The hands-on approach in science improves understanding of concepts resulting in better achievement score and success in science subject area[5].

The frequency of hands-on experience was strongly related to science achievement. It was shown that the students who experience hands-on activities either every day or once a week score significantly higher than the students who experience hands-on activities once a month, less than once a month, or never[8].

2. Method

2.1. Research Design

The study was designed to answer the research question. Pre/post design was used for performance. For attitude ten-item five-scale Likert Scale was used. The dependent variables were student performance and attitude toward biology. The independent variable was doing hands-on activities versus not doing hands-on activities in "The Cell" unit. The hypothesis was if students did hands-on activities in the lessons, then they would be more successful and develop more positive attitudes toward biology than the students who didn't do them.

It may be noticed that students' engagement increases when they are active in the lessons. When they are forced to sit and listen in classical ways, they lose their focusing and mostly using visual

sources doesn't help them to concentrate the lesson. The Turkey's national 9th grade biology curriculum is based on molecular level biology such as organic molecules, DNA, cell organelles and cellular transport, which are very difficult to envisage, interpret and make connections. Students generally complain about that biology is boring, there are too many things to memorize, or biology is really difficult to understand. Students' engagements may be increased in the lessons by creating products such as models, drawings, or games. Besides they may develop positive feelings to the subject and feel that they've understood the concepts.

2.2. Sample

The sample used in this study was forty-five ninth grade students attending Hisar School in Turkey in two different classes which were nearly equal size and consisted of students with mixed abilities. One class was as an experiment group and other class was as a control group.

2.3. Intervention

The intervention occurred in two classes over one unit of study that took 8 weeks to complete. The experiment group was taught lectures with several hands-on activities and the control group didn't do any hands-on activities.

2.4. Instrumentation and Data Collection

This study used a pre/post test design to gather information regarding student success in biology. All students were given a pre-test including 18 questions containing true-false, multiple choice, labelling and matching type questions about cell unit before the unit. In the control group, six weeks and in treatment group, eight weeks following the pre-test, all students were given a post-test containing the same questions.

Student attitude was measured by pre/post Likert Scale Survey to explore student confidence and enjoyment of biology by having students respond to such statements as, "Biology is fascinating and fun," or "It is easy to understand biology topics." Students were asked to rate their level of agreement with these statements using a five- point scale, five being strongly agree and one being strongly disagree. The survey was given before starting the unit and repeated again after completing the unit.

The experiment group did several hands-on activities in the unit of "The Cell". Activities include cell theory time line, making a simple microscope, microscope working mechanism, building models such as organelle models, dynamic modeling of endomembrane system, cell membrane structure, and models of different cell types likes prokaryotic cell, plant cell and animal cell by using play dough, clays, beads, pipe cleaners, etc., observing different types of cells under microscope, laboratory investigations such as substance transport through cell membrane, osmosis, turgid and plasmolysis in plant cells, game design such as "who wants to be a millionaire", "jeopardy", "monopoly", and cell drama. The control group was given only traditional teaching methods.

2.5. Threats to Validity

Selection was one of the remarkable threads to validity. Classes were mixed and students' learning styles were different from each other. If student was not tactile or kinesthetic in an experiment group, hands on activities might not affect their learning positively, even might affect negatively.

Another thread was subject characteristics. Our students were not native speakers and terminology in English might not be enough to answer the questions in the pre-test although they might know the answer. Therefore, they might earn higher grades in the post test.

Regression to mean might be considered as a thread, too. Students might not take the tests seriously.

3. Results

1. Students' biology performance

The test with same questions was given to all students as pre/post tests. An unpaired t-test was conducted to analyze the change in their scores.

As shown in Table 1, the t-test revealed that there is no significant difference at the 5% level of significance between experiment (M= 32.43, SD= 12.53) and control group (M= 27.64, SD= 12.73), $t(43)= 1.2742$, $P=0.2094$. These results suggest that hands on activities don't have effect on students' biology performance.

Table 1: Comparison of Experiment and Control group on biology performance



Group	N	Mean	SD	df	T	P
Experiment	23	32.43	12.53	43	1.2742	0.2094
Control	22	27.64	12.73			

P<0.05

The unpaired t-tests was conducted to analyze the change in biology performance of male students (Table 2). A non-significant difference was found between biology scores of male experiment (M=27.36, SD=12.65) and male control group (M=33.18, SD= 14.97) students, $t(23)=1.0547$, $P=0.3025$. These results indicate that hands-on activities don't have effect on male students' biology performance

Table 2: Comparison of Male Experiment and Control group on biology performance

Group	N	Mean	SD	df	T	P
Experiment	14	27.36	12.65	23	1.0547	0.3025
Control	11	33.18	14.97			

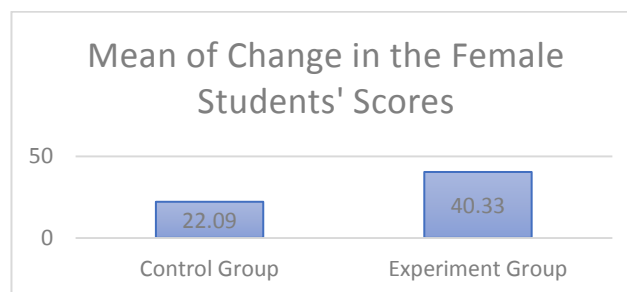
P<0.05

Unpaired t-test (Table 3) revealed that there was a significant difference between biology scores of female experiment and female control group students, $t(18)=5.6256$, $p<0.05$, indicating that female experiment group students (M=40.33, SD=7.53) performed better than female control group students (M= 22.09, SD= 6.95) on biology performance. Therefore, it is concluded that hands on activities have positive impact on female students' biology performance.

Table 3: Comparison of Female Experiment and Control group on biology performance

Group	N	Mean	SD	df	T	P
Experiment	9	40.33	7.53	18	5.6256	<0.0001
Control	11	22.09	6.95			

P<0.05



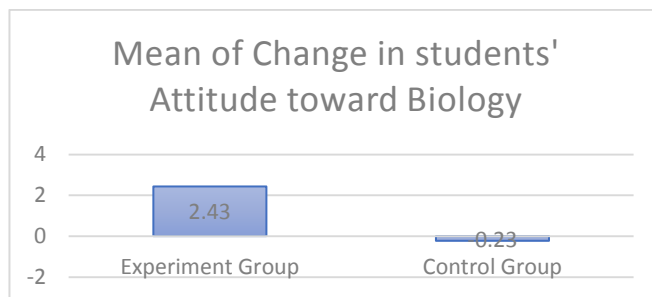
2. Attitude toward biology

The change in the pre/post Likert of experiment group and control group was analyzed by unpaired t-test. As shown in Table 4, there was a significant difference between attitude of experiment group and control group, $t(43)=5.9894$, $p<0.05$, indicating that experiment group students (M=2.43, SD=1.73) developed more positive attitude toward biology than control group students (M= -0.23, SD= 1.19)

Table 4: Comparison of Experiment and Control group on attitude toward biology

Group	N	Mean	SD	df	T	P
Experiment	23	2.43	1.73	43	5.9894	<0.0001
Control	22	-0.23	1.19			

P<0.05



4. Discussion

The results of this study showed that hands-on activities had no positive effect on students' biology performance whereas the students who did hands-on activities developed more positive attitudes toward biology than the other group students who didn't do hands-on activities. On the contrary of Korwin, A.R. and R.E. Jones (1990), Ates and Eryilmaz (2011), and Hussain and Akhtar (2013) who revealed a positive impact of hands-on activities on students' achievement in the researches, the hypothesis failed. According to gender analysis it was found that female students' performance increased by hands-on activities, on the other hand male students' performance didn't show any significant difference. Many previous studies indicated that female students showed lower learning motivation towards science and lower performance of science than male students [6]. Consequently, this method might be considered as a support for female students' motivation and success in science courses.

As a result of the study, it was shown that hands-on activities might be considered as a teaching strategy. It was shown that the students who experienced hands-on activities either every day or once a week scored significantly higher than the students who experienced hands-on activities once a month, less than once a month, or never. The frequency of hands-on experience was strongly related to science achievement[9]. Accordingly, students might be exposed hands on activities regularly and continuously to increase their achievement. The study substantiated that hands-on activities positively affected students' attitude toward biology.

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