The effects of instruction by using experimental hand-made instruments on high school students' achievement in light-refraction

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Abstract. *The current traditional method of teaching physics is not able to do its serious task of public learning and training students. The use of laboratories and laboratory equipment for teaching physics is necessary [3]. But the laboratory facilities are unhandy and insufficient in schools and are unfamiliar in daily lives of students, Therefore, using simple tools that made by simple tools via teacher and students and (hand-made instruments) is suggested.*

This study evaluate the effect of using the experimental hand-made instruments on the first year high school girl students' academic achievement about light-refraction. This study was quasi-experimental in design. And is Solomon four groups design in method. The samples are four groups altogether including97student. School selecting among high schools girls of city as well as groups selecting and assigning them to experimental and control groups in the Solomon design, was simple random sampling.Two experimental groups taught with the use of the hand-made instruments, and two control groups has been experienced by the traditional education in order to assess hypotheses of study was used thepre-test and post test made by researcher. Results of the analyses showed that there was a significant difference ($p< 0.05$) between the experimental and control groups in development of students' academic achievement.

Keywords. Laboratory Hand-made instruments, Academic Achievement, Conceptual Learning, Build Knowledge, Schema.

1. Introduction

Among the experimental sciences, the physics as the science of nature is the most fundamental science. Therefore, Physics Education should be able to pursue relationship between human and nature in their goals. Considering the importance of physics education and it's objectives, and the current traditional method of teaching physics, is not able to do it's serious task of public learning and training students, benefiting from active teaching methods in order to make physics closer to natural living environment of students and communication between them and to make physics tangible and objective for students is required. This led to the realization of conceptual learning and help students to build the correct schema in their knowledge structure [1]. Because according to many behavioural psychologists, including Thorndike, formal education should be similar to real life situations as much as possible. He believes that the amount of "simulation" between a classroom situation and a real life problem determines how much of the classroom learning can be transferred to the real life.

In cognitive theory, what the student is going to learn now should be related to what he already knows. A famous Chinese proverb says: I hear I forget, I see I understand, I do I learn. This is exactly what Kennet W. Spence believes.

The followers of Gestalt theory suggest that formulas, symbols and scientific laws are not very meaningful for learners unless they are closely linked to a person's practical and daily experience.

Constructivists believe that useful knowledge is indeed what the person can produce from his own experiences and actions. Certainly, it will follow that an efficient system of education will strongly depend on the learner characteristics and his/her learning environment.

Therefore, the use of laboratories and laboratory equipment for teaching physics is necessary [3]. The laboratory has been given a central and distinctive role in science education, and science educators have suggested that rich benefits in learning accrue from using laboratory activities.

The *National Science Education Standards* in the United States and other contemporary science

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education literature continue to suggest that school science laboratories have the potential to be an important medium for introducing students to central conceptual and procedural knowledge and skills in science (Bybee, 2000) [6].

But the laboratory facilities are unhandy and insufficient in schools and are unfamiliar in daily lives of students, Therefore, using simple tools that made by simple things and simple objects via teacher and students (hand-made instruments tools) is suggested "figure1".

Figure1. Simple things to hand made.

This study evaluates the effects of using the experimental hand-made instruments on the first year high school female students' academic achievement about light-refraction.

2. Method

2.1. Hypothesis

The hand-made instruments and pre-test and post-test hypotheses were conducted in this study to address the following hypothesis:

- There is difference in students' academic achievement about light-refraction between the students are taught by experimental hand-made instruments and the students that are not taught by experimental hand- made instruments.

2.2. Subjects

The study involved 97 first-year high school girl students in Dehgolan city. They were randomly divided into two control groups (undergoing traditional learning, 3and 4 groups. N=46), two experimental group (undergoing Laboratory hand-made instruments learning with experiment prompting, 1and 2 groups. N=51).

Groups selecting and assigning them to control and experimental groups in the Solomon design, was simple random sampling. In one control and one experiment groups (1and 3) was processed the pre-test. We found any difference between these groups.

This study was quasi-experimental design and Solomon four groups design in method. In this study, the independent variable was the teaching method, which was divided into traditional teaching and teaching by experimental hand-made instruments. The dependent variable was the academic achievement, and MANOVA was obtained from the pretest performance in order to eliminate and control the influence of the learners' previous knowledge on their learning performance.

2.3. Tools

The following tools were employed to evaluate the teaching method:

(1) Experimental hand-made instruments.

(2)Pretest and posttest questions: These questions were formulated based on the topic of the basic characteristics of light refraction in the physics course of a high school. The content of this topic mostly comprised the narration of cognitive knowledge. Two experienced teachers of physics examined and amended the pretest and posttest questions in order to ensure content validity. There are 18 test items. The test–retest reliabilities were .70 and the coefficient for concurrent validity was .37. And in order to investigate reliability tests, Cronbach's alpha is used (r_{α}=.70).

2.4. Procedures

All learners in 1and 3 groups underwent a pretest prior to the commencement of the research. The control groups have taught by traditional teaching and experimental groups 1and 2 performed laboratory learning activities by hand-made instruments. The posttest was applied after the teachings were completed. After the pretest, subjects of experimental groups worked with the experimental hand-made instruments individually. Participants are encouraged to explore the basic concept of light refraction by conducting the experiments by hand-made instruments context. When

conducting the experiment, participants can use the simple things too made simple tools to do experiments and see the effects of light refraction, figure 2.

Figure 2. Hand made by simple things.

Also, they can adjust the original hypothesis based on the concepts discovered in the experiment and get the final conclusion. In contrast with experimental groups, subjects of control groups learned with traditional teaching without hand-made instruments individually.

The posttest was applied after the different teachings were completed.

3. Results

According to significant in table 1 can be said that does not exist the interaction between teaching methods and pre-test. Thus, pre-test does not have different effect on experimental and control groups.

Table1. Test the interaction of variables on academic achievement in light refraction.

Source of changes	Sum of squares	Degree of freedom	Mean of squares	F value	significance
Pre-test* teaching method	0.3	1	.3	.042	.8

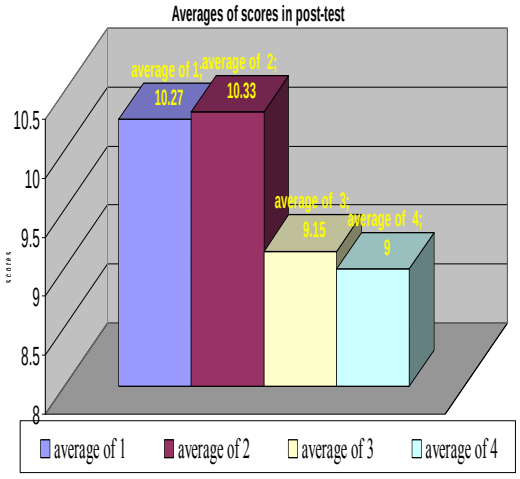
Considering the amount of p value in statistic Anderson-Darling test for normal data can be said that the difference between pre-test and posttest score follows the normal distribution.

As indicated from the results of an independent T-test as listed in Table 2 assumption of equality of variance in experimental and control groups are accepted (F=1. 050, p= .36, p > .05). Considering the significance of two-way test (p=.003<.05) and amount of t (t=2.000) in level less than .05 that is significant. So the hypothesis is confirmed.

Table2. Independent T-test for different of scores

sd	p	t	df	N	Lvans test		group
					P	F	
	.003	2.000		25	.360	1.050	**experiment**
				25			**control**

Chart 1. Scores frequency distribution of control and experimental groups post-test.



4. Conclusion

We found that the learning results are better for teaching by experimental hand-made instruments than traditional teaching, which is consistent with the results of previous studies (Elizabeth Aronsohn (2003) Ying-Shao Hsu (2000), Clora Mae Baker (1980), Dave. H. Jonassen (1996), Richard R. Taylor (1991) and some of scientists and researcher that worked in this field [2, 3, 4 and 5]. We also found that the learning performance was better when using experimental hand-made instruments. In other words, the cognitive learning of learners who learned how to made hand-made instruments and use them to see the effects of light refraction law, was progressed. Because seeing and studying that how light enters the different environment, helps the learners to focus on learning the concepts. Based on the findings of this study, we recommend using of experimental hand-made instruments in a teaching system.

When learners made hand-made instruments by simple tools and things, they learn what

characteristics of light cause action of light in different transparent material. Students learn how to use the light refraction law in a phenomenon.

5. References

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