# CAN WE CHANGE ATTITUDE TOWARD PHYSICS? OUTCOMES OF TECHNOLOGY SUPPORTED AND LABORATORY BASED INSTRUCTIONS

Feral Ogan-Bekiroglu
Marmara University, Turkey

Onur Oymak
Marmara University, Turkey

**ABSTRACT**: Attitudes are inferred internal states that appear to modulate behavior. School, particularly classroom, variables such as how well students like their teachers, the science curricula, or the science classroom climate have been found to be key influences on attitudes toward science. This research was framed by activity theory model. The following research question put a light on this research: Is there a significant difference among the attitudes of students towards physics exposed to hands-on laboratory instruction, the attitudes of students exposed to technology supported instruction, and the attitudes of students exposed to curriculum-based instruction? True experimental design was carried out for this research. The participants of this study were 144 $9^{th}$ grade students studying in an all-boys state high school. The students who were in the technology supported classroom constituted the first experimental group while the students in the laboratory based classroom comprised the second experimental group. There was also one control group whose students were taught based on the curriculum. Each group had 48 students. Teacher of three groups was the same person. Data were collected in the physics lessons. In order to determine any change in the students' attitudes towards physic, "Physics Lesson Attitude Scale" was used. Effect sizes were calculated for the changes in students' attitudes. Two conclusions can be drawn from the study. First, when students are given a chance to engage with technology supported and laboratory based instructions, they tend to develop more positive attitudes toward physics. And second, there is no difference between the technology supported instruction and laboratory based instruction in terms of their impact on students' attitudes toward physics.

**Keywords:** Attitude, instruction, technology, laboratory, science

## INTRODUCTION

Attitudes are inferred internal states that appear to modulate behavior (Gagne, 1984). In general, attitudes are considered to include three different aspects. One is a cognitive aspect, that is, an idea or a proposition. The second is an affective aspect, the feelings that accompany the idea. The third is a behavioral aspect that pertains to the readiness or predisposition for action (Gagne, 1985, p.222). Attitude towards science is often treated as one concept, but includes many dimensions depending on different meanings of "science" and in which contexts these occur (Barmby, Kind, & Jones, 2008). Siegel and Ranney (2003) state that modest positive correlations between science attitude and science achievement have been reported in many studies; as a result, work in the realm of students' attitudes toward science has been motivated by the desire to increase interest, performance, and student retention in science (Third International Mathematics and Science Study, as cited in Siegel & Ranney, 2003). However, a concern for many countries is the falling numbers of students choosing to pursue the study of science, alongside the increasing recognition of the importance and economic utility of scientific knowledge (Barmby, et al., 2008). During the last three decades many researchers have reported declines in attitudes toward science among students of all ability levels during middle or high school (Zacharia & Barton, 2004). School, particularly classroom, variables such as how well students like their teachers, the science curricula, or the science classroom climate have been found to be key influences on attitudes toward science (Zacharia & Barton, 2004). Therefore, the purpose of this research was to examine if students' attitudes towards science would change when the instruction is changed.

## THEORETICAL FRAMEWORK

This research was framed by activity theory model which represents activity as a dynamic unity of several elements which interact with each other as an activity develops (Engeström, Miettinen & Punamäki, 1999). The subject of activity can be either a teacher or a learner depending on the purposes of analysis. When considering a teacher's activity, the object of the activity can be seen as enhanced teaching using a pedagogical tool (Kaptelinin & Nardi, 2006).

According to Engeström, Miettinen and Punamäki (1999), activity is motivated by the objects to be changed and object orientedness as well as mediation by tools is one of the most distinguishing characteristics of activity. Tools are seen as having extended human ability to achieve the goals of an activity; that is, to change objects in the world. This theory treats tools as a means of meeting real needs and achieving corresponding goals (Kaptelinin & Nardi, 2006).

Correspondingly, it was assumed that students' attitudes towards physics would change when a teacher used tools, i.e. technology and laboratory experiments.

## EFFECTS OF INSTRUCTIONAL STRATEGIES ON STUDENTS' ATTITUDES

The rapid growth of computing and networks offers increasing and ever-changing potentials for technology use in education. Technology simultaneously ushers the tasks of creating, evaluating, analyzing, and applying through collaboration into the classroom while generating greater enthusiasm for learning (Cicconi, 2014), which is related to attitude. Students indicate higher interests in learning strategies related to technology (La Velle, McFarlane, & Brawn, 2003). Ranging from drawings on a blackboard or interactive multimedia simulations to etchings on a clay tablet or Web-based hypertexts to the pump metaphor of the heart or the computer metaphor of the brain, technologies have constrained and afforded a range of representations, analogies, examples, explanations, and demonstrations that can help make subject matter more accessible to the learner (Koehler & Mishra, 2008).

Considerable amount of research has focused on the impact of using technology on students' attitudes. Marty (1985), for example, investigated the effects of interaction with computerized simulation game on high school students' attitudes. Analysis revealed very little difference in the change of class means on attitudes. Grimm (1995) examined the effect of technology rich educational environments on student attitude by comparing type of school (technology-rich school (TRS) and traditional school (TS)). The overall findings indicated that TRS environments contributed to students' overall attitudes for $6^{th}$-grade and $ll^{th}$-grade students. The participants of the research done by Kenar, Balci and Gokalp (2013) were fifth grade students who were divided in two groups. The experimental group was instructed with tablet computer assisted instruction and the control group was instructed with traditional methods during science and technology courses. The results of the study showed that the tablet computer assisted instruction had both negative and positive impacts on the students' attitudes toward science.

Encouragement also continuous for implementing hands on science and laboratory activities. Hands-on approach in science education provides the student with engaging activities during the learning process (Wiggins, 2006). Research implies that when properly designed use of the laboratory and hands-on activities can influence attitude toward science in a positive way (Freedman, 1995).

Some research investigated the benefits of laboratory instruction on students' attitudes towards science. For instance, Norton (1985) compared college students in the experimental group who were told to work independently and did not get any instructional help with the students in the control group who continued with step-by-step verification laboratory exercises, working in pairs with direct supervision and instruction. Results indicated that the treatment of the independent laboratory investigation did not have a significantly different effect on the dependent measures of scientific attitude when compared to the effect of the performance of verification laboratory exercises by a control group. Freedman (1997) investigated the use of a hands-on laboratory program as a means of improving student attitude toward science. It was concluded that laboratory instruction influenced, in a positive direction, the students' attitudes toward science. Adesoji and Raimi (2004) examined the effect of supplementing laboratory instruction with problem solving strategy and or practical skills teaching on students' attitudes toward chemistry. Senior secondary class II students took part in the study. The results revealed that the use of enhanced laboratory instructional strategy significantly improved the attitudes of students toward chemistry. Wiggins (2006) concerned with the influence of hands-on science instruction versus traditional science instruction on middle school students' attitudes. A statistically significant difference was not found in the attitude scores of middle school students who were exposed to hands-on or traditional science instruction.

Some research compared the impact of technology with effects of laboratory (Azar & Sengulec, 2011; Coramik, 2012; Darrah et al., 2014; Finkelstein et al., 2005; Zacharia & Anderson, 2003). Azar and Sengulec (2011) stated that computer-assisted teaching with the participation of 50 students from high school 9th grade with simple electrical circuits might be more effective in the attitudes of the students towards the physics lesson than the laboratory assisted teaching. Coramik (2012) explored the outcomes of using computers and experiment-assisted activities in the teaching of the magnetism unit in the 11th grade physics course to the students' attitudes towards the physics course. It was seen that attitude scores of the students in the experiment-supported teaching group were higher than the scores of the students in the computer-assisted teaching group.

Research produced miscellaneous results; hence, more studies are needed to reveal which instructional strategy is more influential in changing students' attitudes. Moreover, research comparing technology supported instruction to hands-on laboratory activities with each other and to curriculum-based instruction is not ample. Thus, the following research question put a light on this research: Is there a significant difference among the attitudes of students towards physics exposed to hands-on laboratory instruction, the attitudes of students exposed to technology supported instruction, and the attitudes of students exposed to curriculum-based instruction?

## METHOD

True experimental design was used for this research (Krathwohl, 1997). There were two experimental groups and one control group. The first experimental group was instructed with technology supported teaching and the second experimental group was instructed with laboratory based teaching while the control group followed the curriculum and was exposed to curriculum based teaching. The participants of the study were 144 9th grade male students. Each group had 48 students. The research was conducted in a physics class in an all-boys state high school. Teacher of all groups was the same person. The students were taking the class two hours a week. The instruction continued in the dynamics unit and lasted 8 weeks. Simulations, video recordings, smart board, tablets and z-book were used as the technology in the first experimental group. The second experimental group did hands on science by using experiment sets.

Quantitative research methods were used to gather data. In order to measure the changes in the participants' attitudes towards physics, Physics Class Attitude Scale (PCAS) developed by Geban et al. (1994) was applied to the participants before and after the treatment. This instrument consisted of 15 items with 5-point Likert scale. The scoring was between 15-75. The following factors constituted of the instrument: Liking physics, interest to physics, and necessity of physics. Descriptive statistics and t-tests were performed to analyze the data. Effect sizes were calculated for the changes both within and between the groups. Reliability measurements were made with the help of Cronbach alpha test.

## RESULTS AND DISCUSSION

The application of Physics Class Attitude Scale had high reliability where Cronbach Alpha value for the pre-test was .90 while this value was .93 for the post-test. Table 1 presents that there was no significant difference among the groups' pre-test results when the attitude took into account.

Table 1. Independent t-Test Results of the Groups' Pre-Tests

| Groups | n | $\bar{x}$ | ss | t | sd | p |
|---|---|---|---|---|---|---|
| Technology | 44 | 47.57 | 9.89 | | | |
| Laboratory | 43 | 49.09 | 9.70 | -.726 | 85 | .470 |
| Total | 87 | | | | | |
| Technology | 44 | 47.57 | 9.89 | | | |
| Curriculum based | 44 | 49.70 | 11.51 | -.934 | 86 | .353 |
| Total | 88 | | | | | |
| Laboratory | 43 | 49.09 | 9.70 | | | |
| Curriculum based | 44 | 49.70 | 11.51 | -.268 | 85 | .790 |
| Total | 87 | | | | | |

However, according to Table 2, significance differences were explored within the technology and within the laboratory groups in terms of pre- and post-test results. Technology group significantly increased their mean values for attitude toward physics from 47.57 to 54.72 (p = .001). Similarly, the laboratory group's mean value significantly improved from 49.09 to 56.45 (p = .00). Effect sizes (Hedges & Olkin, 1985) for the post-application of the PCAS neither in the technology group (d = .36) nor in the laboratory group (d = .38) were not found to exceed Cohen's (1988) convention for a large effect (d = .80). However, little advancement in the curriculum-based group's attitude towards physics from the pre-test to post-test was not significant. Results indicate that when the students involved with more activities including technology and laboratory, their attitudes towards physics class enhanced.

Table 2. Dependent t-Test Results Within the Groups' Pre- and Post-Tests

| Groups | n | $\bar{x}$ | ss | t | sd | p |
|---|---|---|---|---|---|---|
| Technology pre-test | 44 | 47.57 | 9.89 | | | |
| Technology post-test | 43 | 54.72 | 8.57 | -3.602 | 85 | .001 |
| Total | 87 | | | | | |
| Laboratory pre-test | 43 | 49.09 | 9.70 | | | |
| Laboratory post-test | 47 | 56.45 | 7.80 | -3.978 | 88 | .000 |
| Total | 90 | | | | | |
| Curriculum based pre-test | 44 | 49.70 | 11.51 | | | |
| Curriculum based post-test | 37 | 45.38 | 15.10 | 1.428 | 66.511 | .158 |
| Total | 81 | | | | | |

Additionally, significance differences were found between the post-tests of the technology group and curriculum-based group as well as between the laboratory group and curriculum group as seen in Table 3. The mean value of the technology group ($\bar{x}$ = 54.72) was significantly higher than the mean value of the curriculum-based group ($\bar{x}$ = 45.38, p = .002). Likewise, the laboratory group's mean value ($\bar{x}$ = 56.45) was significantly higher than the curriculum-based group's mean value ($\bar{x}$ = 45.38, p = .00). The effect size between the technology and curriculum based groups was .35 and the effect size between the laboratory and curriculum based groups was .42. In addition, there was not any significant difference between the post-tests of the technology group and laboratory group. In other words, neither technology supported instruction nor laboratory based instruction displayed superiority on attitude toward science. This finding explains the miscellaneous results in the literature.

Table 3. Independent t-Test Results of The Groups' Post-Tests

| Groups | n | $\bar{x}$ | ss | t | sd | p |
|---|---|---|---|---|---|---|
| Technology | 43 | 54.72 | 8.57 | | | |
| Laboratory | 47 | 56.45 | 7.80 | -1.000 | 88 | .320 |
| Total | 90 | | | | | |
| Technology | 43 | 54.72 | 8.57 | | | |
| Curriculum-based | 37 | 45.38 | 15.10 | 3.331 | 55.090 | .002 |
| Total | 80 | | | | | |
| Laboratory | 47 | 56.45 | 7.80 | | | |
| Curriculum-based | 37 | 45.38 | 15.10 | 4.054 | 50.975 | .000 |
| Total | 84 | | | | | |

Technology group developed more attitude towards physics class than the curriculum based group. This result is consistent with the results presented by Marty (1985) and Grimm (1995). Laboratory group performed more progression in their attitudes than the curriculum based group. This finding is in line with the results that emerged from the research by Freedman (1997). The results revealed that science instruction that was activity-based (Freedman. 1997) was shown to enhance positive attitudes toward science.

Attitude change takes time and needs having experiences. Since there was not any change in terms of instruction in the curriculum-based group, any change in attitudes of the students' in the curriculum-based group was not expected. Since the participants were ninth grade students and studied physics discipline for the first time, eight-week duration was enough for the students in the technology and laboratory groups to change their attitudes.

## CONCLUSIONS AND SUGGESTIONS

Two conclusions can be drawn from the study. First. when students are given a chance to engage with technology supported and laboratory-based instructions, they tend to develop more positive attitudes toward physics. And second, there is no difference between the technology supported instruction and laboratory based instruction in terms of their impact on students' attitudes toward physics.

Haladyna, Olsen and Shaughnessy (1982) posit that students' attitudes toward science are determined by three independent constructs: teacher, student, and learning environment. Results of this study show that when learning environment is changed by changing the instruction, students' attitudes toward science alter in a positive way.

The results underscore the need for high school science teachers to adopt the use of laboratory based and technology supported instructions in order to promote high level attitude toward science, which stimulates students' learning of science.

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