The Usage of Alternative Assessment Techniques in Determination of Misconceptions about Electromagnetic Field-Magnetism Contents and Effects of Video-Based Experiments on Students’ Achievement at Distance Learning Course

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Abstract

In this study at the first stage, alternative assessment techniques were constructed to determine students’ misconceptions in the electromagnetic field-magnetism contents and at the second stage, effects of video-based experiments on students’ achievement were examined at distance physics course. 60 second-year students were enrolled in this study from computer education and instructional technology department. Students’ misconceptions were determined using by alternative assessment techniques which are branched diagnostic trees, structured grid and concept map constructed and used as pre-test. Then, video-based experiments were used and the alternative assessment techniques were conducted to students. Paired-samples t-test results indicate that video-based experiments have significant effect on students’ achievement at distance physics course.

Keywords: Distance Education; Computer Assisted Learning; Physics education; Alternative Assessment Technique; Electromagnetic field-Magnetism.

1. Introduction

Nowadays, the multidimensional and complex character of the domains to be assessed is clearly recognized in distance education. And so is the need to assess them in combination with the application contexts in distance education (Sangra, 2007). However, today's distance education systems, learning has been traditionally measured quantitatively, basically through written examinations, objectives and
contents (Brown et al., 1997). Today, the paradigm in distance education assessment has changed. Some of these changings are “tool to certify” to “tool to promote learning”, “academic disciplines” to “professional competencies”, “uniformity of techniques” to “diversity of techniques” and “final assessment” to “continuous assessment”. Under the basis of the mentioned emerging trends in distance education, we would assume these trends are making the scenario change when using technology in education (Badía, 2002). Therefore, theorists tried to find the most recommendable assessment approaches to open and distance education (Morgan & Reilly, 1999). Web-supported materials and assessment tools are of great importance in technology-supported science education. But, studies have been focused on technology supported material development. It has been reported that these types of materials have positive effects on learning (Gabbard, 2000; Wen et al., 2004; Chuang & Tsai, 2005). The new studies are more focused on alternative assessment and evaluation approach and include techniques that consider not only the product but the process along with it (Taşdere & Ercan, 2011). Three of these techniques are the concept map, branched diagnostic tree and structured grid.

“Concept map” is graphical tools in order to summarize understandings acquired by students (Mintzes et al., 2000). “Branched diagnostic tree” can utilize much of the information content in quantitative measurements to make efficient and accurate diagnoses (Jolly & Zalondek, 1989). “Structured grid” is an important assessment tool in that it provides assessment of meaningful learning and manifests the shortcomings and defects in knowledge network and in misconceptions in student cognitive processing (Johnstone et al., 2000).

One of the frequently studied topics in education is misconceptions. There are identified student misconceptions related to many learning field and topic (solubility, electric, photosynthesis-respiration, diffusion, osmosis etc) (Chambers& Andre, 1997; Mikkila, 2001; Çalık & Ayas, 2003; Sencar & Eryılmaz, 2004; Köse & Uşak, 2006). These studies have often made use of similar type tests (multiple choice, open-ended questions, two-stage tests, interviews etc) in order to identify misconceptions. According to Çalık & Ayas (2003) although multiple tests provide us with information related to student misconceptions, they do not allow for deeper understanding of the issue. In this context it becomes more important to use alternative assessment techniques that evaluate meaningful and deeper learning and that expose the relationships among concepts in the cognitive structure (Taşdere & Ercan, 2011).

When we look at the literature in distance education, we find some application of these alternative assessment techniques in distance education. However, we cannot find the application of three alternative assessment techniques together in distance education. In this context, in our study we applied three alternative assessment techniques in distance education for the purpose of alternative assessment in distance education supported by video based instruction and determining of misconceptions.

2. Methods

2.1. Purpose of the research

The purpose of this study is to determine distance education students’ misconceptions in the electromagnetic field-magnetism contents using by alternative assessment techniques and to examine the effects of video-based experiments on students’ achievement. In the context of this study, the following research questions were investigated.

1. Do students have misconceptions about electromagnetic field and magnetism?
2. Are the alternative assessment techniques effective to determine distance education students’ misconceptions?
3. How effective is video-based experiments in preventing distance education students’ determined misconceptions about electromagnetic field-magnetism contents?

2.2. Participant

The participant of this study was 60 second-year distance learning students (average age 20-21 years) at Department of Computer Education and Instructional Technology in a public university in Istanbul, Turkey. The socio-economic status of the students was similar and the majority of them are coming from middle-class families. According to Turkish Educational Curriculum, students learn electromagnetic field and magnetism subjects under distance general physics II course at the second semester.

3. Instruments

In this study; alternative assessment techniques which are branched diagnostic trees, structured grid and concept map were selected to identify students’ misconceptions about the electromagnetic field-magnetism contents. Many physics educators have indicated that students’ knowledge plays an important role on conceptual learning (Bodner, 1986). Therefore, many researchers have investigated students’ knowledge known as students’ misconceptions (Osborne, 1983). They reported that the most important significant things that students bring with them to class existing ideas, notions and explanations of natural phenomena that are inconsistent with the ideas accepted by the scientific community (Osborne, 1983; Ausubel, 1968; Ausubel, 2000; Driver, 1986; Driver, 1978). If students’ these existing conceptions are scientifically incorrect, they are called as “misconceptions” (Driver, 1978).

Students’ misconceptions were determined using by alternative assessment techniques which are branched diagnostic trees, structured grid and concept map constructed and used as pre-test by researchers electromagnetic field-magnetism concepts. The prepared alternative assessment techniques’ scores classified as correct (1 point), incorrect (0 points) and blank answer (0 points). Each of the answers was evaluated by the researchers and the scores were compared and discussed until an agreement was reached. Then, 3 different experiment videos which are prepared by researchers were used to teach more detailed for each concept. After the video-based experiments, the alternative assessment techniques were conducted to students as post-test.

3. Findings

Paired-samples t-test results were used to compare students’ pre-test and post-test scores. The analysis showed that there was statistically significant difference between pre-test and post-test scores (p= .000*). Paired-samples t-test results indicate that video-based experiments have significant effect on students’ achievement.

Table 1. Comparison of pre-test and post-test scores of pre-services according to paired samples t-test results.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>Paired samples t test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>42,9667</td>
<td>60</td>
<td>6,36986</td>
<td>.82235</td>
<td>-10,934</td>
</tr>
<tr>
<td>Post-Test</td>
<td>47,7833</td>
<td>60</td>
<td>5,14235</td>
<td>.66387</td>
<td>59</td>
</tr>
</tbody>
</table>

*p < .05*
Responses of the students to the pre-test and post-test showed that they had 7 misconceptions about magnets, magnetic field, magnetic poles, charged particle in a magnetic field, magnetic field of a wire, magnetism properties of the matter, magnetic field effect of electric current concepts (Table 2). These misconceptions were not seen as much as after the detailed video based instruction.

Table 2. Percentages of students’ misconceptions determined at the pre-test and post-tests in experimental and control groups.

<table>
<thead>
<tr>
<th>Students’ Misconceptions</th>
<th>(N=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Test (%)</td>
</tr>
<tr>
<td>1. Magnitude of the magnetic force does not depend on velocity of charged particle.</td>
<td>37.0</td>
</tr>
<tr>
<td>2. Magnetic force is parallel to the plane formed by magnetic field and velocity vectors.</td>
<td>33.0</td>
</tr>
<tr>
<td>3. The magnetic force acted a positive charge is the same direction with the magnetic force acted a negative charge.</td>
<td>37.0</td>
</tr>
<tr>
<td>4. Two wires conducting in the same direction current pull each other.</td>
<td>28.7</td>
</tr>
<tr>
<td>5. Two wires conducting in opposite direction current attract each other.</td>
<td>32.4</td>
</tr>
<tr>
<td>6. A magnet attracts all metals.</td>
<td>45.6</td>
</tr>
<tr>
<td>7. Right-hand rules.</td>
<td>33.6</td>
</tr>
</tbody>
</table>

5. Conclusion

There is a direct relationship between technology and constructivism. According to constructivism, an individual does not accept the knowledge without any qualification, but constructs discursive, defending opinions, hypothesizing and questioningly (Hendry, 1999; Shunk, 1996). Constructivist learning predicts a rich and interactive learning environment. To provide this, students requires reaching the knowledge, results and data using by analyzing arranging and using them. In this regard, constructivist learning theory encourages the students doing about something instead of learning about something (Demirci, 2009). This learning approach is a consistent way with alternative assessment techniques.

The purpose of this study is to determine students’ misconceptions in the electromagnetic field-magnetism contents using by alternative assessment techniques and to examine the effects of video-based experiments on students’ achievement at distance physics course. For the purpose of determining students’ misconceptions about the electromagnetic field - magnetism contents, alternative assessment techniques which are branched diagnostic trees, structured grid and concept map were used. In the beginning of the study, alternative assessment techniques conducted to students as pre-test and misconceptions were determined.

According to the results, students had 7 misconceptions about magnets, magnetic field, magnetic poles, charged particle in a magnetic field, magnetic field of a wire, magnetism properties of the matter, magnetic field effect of electric current concepts. In this study, alternative assessment techniques were used to determine students’ concepts in detailed. After the determination of the misconceptions, 3 different experiment videos which are prepared by researchers were used to teach more detailed for each concept and alternative assessment techniques were conducted to students as post-test. The results showed that determined misconceptions were not seen as much as after the detailed video based instruction.

This study has a great importance and makes huge contribution using by three alternative assessment techniques together in distance education. In this context, in our study we applied three alternative assessment techniques in distance education for the purpose of alternative assessment in distance education and determining of misconceptions.
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References


