The Usage Of Alternative Assessment Techniques In Determination Of Misconceptions About Electromagnetic Field-Magnetism Contents And Effects Of Video-Based Experiments On Pre-services’ Achievement

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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. The participant of this study was 55 first-year students from science teaching 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.

Keywords: Physics education; Computer Education; Alternative Assessment Techniques; Electromagnetic field; Magnetism; Misconception.

1. Introduction

Assessment is formally defined as a measure of performance (Gagne et al., 2005). Educational assessment is the process of documenting, usually in measurable terms, knowledge, skills, attitudes and beliefs. Assessment is a mechanism for providing instructors with data for improving their teaching methods and for guiding and motivating students to be actively involved in their own learning. As such, assessment provides important feedback to both instructors and students. In addition to providing the instructors with valuable information about our students’ learning, assessment should assist the students

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in diagnosing their own learning (Angelo & Cross, 1993). Traditional testing methods have been limited measures of student learning, and equally important, of limited value for guiding student learning. These methods are often inconsistent with the increasing emphasis being placed on the ability of students to think analytically, to understand and communicate at both detailed and “big picture” levels, and to acquire life-long skills that permit continuous adaptation to workplaces that are in constant flux. 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 science teaching 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 & Üşak, 2006). Bahar et al (2002) identified levels of student understanding and student misconceptions regarding Newton’s law of motion, work, force and energy in 10th grade physics topics by using structured grid technique. According to the results and misconceptions in understanding the effect of force on motion (Bahar et al., 2002). Bahar & Hansell (2000) prepared a structured communication grid of 16 items in order to identify student views on vitality and questioned 1000 students in primary and secondary level students about the items on the grid. Results displayed that a substantial number of students had misconceptions.

Undergraduate students and in-service teachers have some difficulties especially in alternative assessment methods at learning and application (Ozen, 2006; Birgin & Gurbuz, 2008). Science teachers prepare alternative measurement tools according to students’ levels. But, there are difficulties in the effective usage of the alternative assessment tools such as project, performance task, portfolio, concept map, structured grid, branched tree, rubric, interview, etc.. To overcome application problems, 3 different teaching and assessment techniques were used in this study. When studies in literature are reviewed, we find some application of alternative assessment techniques. However, we cannot find the application of three alternative assessment techniques together in higher education. In this context, in our study we applied three alternative assessment techniques in higher education for the purpose of alternative assessment in higher education and determining of misconceptions.

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 of the study, effects of video-based experiments on pre-services’ achievement were examined.

2. Methods

2.1. Purpose of the research

The purpose of this study is to determine science education pre-services’ misconceptions in the electromagnetic field-magnetism contents using by alternative assessment techniques and to examine the effects of video-based experiments on pre-services’ 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 pre-services’ misconceptions?
3. How effective is video-based experiments in preventing pre-services’ determined misconceptions about electromagnetic field-magnetism contents?

2.2 Participant

The participant of this study was 55 first-year undergraduate students (average age 19-20 years) at Department of Science Teaching in a public university in Istanbul, Turkey. The socio-economic status of the undergraduates 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 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 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 was used to compare pre-services’ pre-test and post-test scores. The analysis showed that there was statistically significant difference between pre-test and post-test scores (p= .001*). 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>33,44</td>
<td>55</td>
<td>6,256</td>
<td>0,844</td>
<td>-3,673</td>
</tr>
<tr>
<td>Post-Test</td>
<td>38,75</td>
<td>55</td>
<td>8,327</td>
<td>1,123</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 1. Comparison of pre-test and post-test scores of pre-services according to paired samples t-test results.
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>Pre-Test (%)</th>
<th>Post-Test (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Magnitude of the magnetic force does not depend on velocity of charged particle.</td>
<td>47.0</td>
<td>23.0</td>
</tr>
<tr>
<td>2. Magnetic force is parallel to the plane formed by magnetic field and velocity vectors.</td>
<td>45.0</td>
<td>30.0</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>53.0</td>
<td>29.3</td>
</tr>
<tr>
<td>4. Two wires conducting in the same direction current pull each other.</td>
<td>34.8</td>
<td>12.0</td>
</tr>
<tr>
<td>5. Two wires conducting in opposite direction current attract each other.</td>
<td>38.3</td>
<td>24.5</td>
</tr>
<tr>
<td>6. A magnet attracts all metals.</td>
<td>51.3</td>
<td>32.3</td>
</tr>
<tr>
<td>7. Right-hand rules.</td>
<td>63.1</td>
<td>25.5</td>
</tr>
</tbody>
</table>

5. Conclusion

Gilbert, Osborne and Fensham (1982) suggested that students brought their views to science lessons. These are logical to students and have a considerable influence on how and what they learn from their classroom experiences. For meaningful learning, one alternative way is to change the instruction using a constructivist approach. In the conceptual change based instruction, several instructional tools or strategies can be used frequently for determining and eliminating misconceptions in science called as alternative assessment techniques.

The purpose of this study is to determine science education pre-services’ misconceptions in the electromagnetic field-magnetism contents using by alternative assessment techniques and to examine the effects of video-based experiments on pre-services’ achievement. To determine 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 makes a huge contribution using by three alternative assessment techniques together in higher. In this context, in our study we applied three alternative assessment techniques in higher education for the purpose of alternative assessment in higher education and determining of misconceptions successfully.
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References


