A Study on Misconceptions of Senior Class Students in Some Physics Topics and the Effect of the Technique Used in Misconception Studies

Tuncay TUNÇ, Hatice Kübra ÇAM, İlbilge DÖKME

1 Asst.Prof. Dr., Aksaray University, Education Faculty, Science Education Department, Aksaray - TURKEY
2 Teacher, Republic of Turkey Ministry of National Education, Ankara - TURKEY
3 Assoc. Prof. Dr., Gazi University, Gazi Education Faculty, Ankara - TURKEY

Received: 06.08.2011 Revised: 21.02.2012 Accepted: 12.03.2012

The original language of article is Turkish (v.9, n.3, September 2012, pp. 137-153)

Keywords: Misconception; Pre-Service Class Teachers; Physics; Three-Tiered Test

SYNOPSIS

INTRODUCTION

All children come to school with conceptual frameworks obtaining from their past experiences. But most of these conceptual frameworks are filled with non-scientific mistakes. Misconceptions might also be referred to as preconceived notions, non-scientific beliefs, naive theories, mixed conceptions, or conceptual misunderstandings (Driver & Easley, 1978; Viennot, 1979; Caramazza, Closkey & Green, 1981; Eryılmaz & Tatlı, 1999; Gülçięk & Yaşban, 2004; Demirci & Çirkinol, 2004). People try to understand, interpret and explain the evolving nature events around them from the moment they are born. A person is affected by many non-scientific sources such as environment, written and visual media in addition to family. All of these activities constitute the pre-experience in the brain of students. Researchers have suggested that the misconceptions are due to the following reasons:
- From Students' daily experiences and observations (Vienot, 1979; Strauss, 1981).
- From diagrams or statements in textbooks (Cho, Kahle & Nordland, 1985).
- From Teachers and student teachers (Osborne & Cosgrove, 1983).
- From the use of perceptual thinking, which is related to the previous source, and is seen in a number of studies where students' explanations of scientific phenomena are dominated by what is immediately perceptible (BouJaoude, 1991).

Although they are of main branches class teachers have negative attitudes towards science courses, especially physics and chemistry (Ahtee & Johnston, 2006). Researches show that class teachers and student teachers themselves do not feel adequate in science, do not make adequate laboratory applications, have significant misconceptions and teach these misconceptions to the students (Kruger, Palacio & Summers, 1992; Sökmen, Bayram & Gürdal, 2000; Kaptan & Korkmaz, 2001). Besides, many class teachers attach less importance to science lessons than the other lessons and don’t feel well in science lessons (Smith & Neale, 1989; Schibeci & Hickey, 2000; Papageorgiou, Kogianni & Makris, 2006; Küçüközer, 2010; Anıl & Küçüközer, 2010).

Various measurement techniques have been used to determine the misconceptions of people in national and international researches. The most widespread ones of these techniques are multiple-choice tests, tests consisting of open-ended questions (Hewson & Hewson, 2003), clinical interviews (Boeha, 1990), annotated multiple choice tests (Atasoy & Akdeniz, 2007), concept cartoons (Bilgili, Duran & Ballıel, 2011), concept maps (Şen & Aykutlu, 2008), two and three-tiered tests (Eryılmaz & Tatlı, 1999; Eryılmaz & Sürmeli, 2002). But, the validity of these tests is the subject of debate. A misconception should not be confused with scientific error.

If a person explains a concept as unscientific, we can’t say that he has certain misconceptions. People could have made the definition of concept as a result of scientific error, contradiction in terms or misconception. If a person realizes his unscientific definition and defines correctly, person then he makes a scientific mistake (Yağbasan, 2004; Güneş, 2011). Similarly, each incorrect answer of the students in the tests is not misconception. If students give a wrong description for a wrong answer and if they are sure of their description then it can be said that they have misconceptions (Eryilmaz & Sürmeli, 2002). So misconception tests show significant differences in other tests. Some researchers prefer to use two or three-tiered tests with multiple-choice questions to make an easy application and to analyse the results easily. In this study, a test which consists of three-tiered annotated multiple-choice questions was used (Eryilmaz & Sürmeli, 2002).

**PURPOSE OF THE STUDY**

The purpose of this study is to determine the misconceptions of senior class students on basic physics conceptions with three-tiered annotated multiple choice questions. This study also reveals the effects of the technique used in misconception studies to the results of the study.

**METHODOLOGY**

In the developing of the conceptual test with three-tiered annotated multiple choice questions, the technique used by Eryilmaz & Sürmeli (2002) was used. Each question used in the test, consists of three tiers. First tiers of the each question of the developed three-tiered tests included five or six choices. These choices are the situations that
students are having misconceptions. Second tier of the each question included five or six choices for students to explain their reason “why they chose this choice. In third tier of the each question included two choices for students to mark whether they can be sure from their answers in first two tiers.

a) The Sample

The sample of the study consisted of 301 senior class students from seven education faculties in different universities of in Turkey.

b) Analysis of the Data Obtained from Conceptual Test

Excel and SPSS programs were used in the analysis of the data obtained from the conceptual test. Marks are given to the each tiers of the test and the total marks of these tiers are calculated.

c) Reliability Analysis of Test

The data obtained from this application were evaluated in SPSS, Cronbach alpha coefficient value of the test for four questions was found 0.69. As the reliability coefficient of the test was 0.69, it can be concluded that the test was reliable.

d) Validity Analysis of Test

A conceptual test with three-tiered annotated multiple choice questions was developed. The conceptual framework of test was constructed by using primary school science curriculum in Turkey under cover of literature and six specialist in the field with aim of ensuring the validity. First, this test was administered 49 senior class students of primary school teaching program in Gazi Education Faculty. At the end of the pilot study, data collection material was revised. This conceptual test was implemented 301 senior class students of primary school teaching program in seven education faculties in different universities of Turkey.

FINDINGS

Here, this paper highlights teachers’ misconceptions concerning some basic science conceptions in the areas of motion (Newton’s first law), electric current and electron motion, light, vision, and sound. In the first question that is related physical event, force and velocity relationship was asked. According to data analysis, the students’ numbers with misconception are 60 that answered, explained wrong and being sure of explaining in this question. 20% of the students had misconception that a force is needed to keep an object moving with a constant speed. Second question is related with the flow of electrons in the circuit. The number of students with misconception is 91 that answered, explained wrong and being sure of explaining in this question. 30,23% of the students had misconception that electrons flow at the speed of light in the circuit. Frequency, wavelength, color and scattering of light were examined in another question. The number of students with misconception are 92 that answered and explained wrong and being sure of explaining in this question. 30,5% of the students had misconception about frequency, wavelength and loudness and pitch of sounds were examined in another question. The number of students with misconception are 49 that answered and explained wrong and being sure of explaining in this question. 16,27% of the students had misconception that loudness and pitch of sounds are confused with each other.
This study also revealed the effects of the technique used in misconception studies to the results of the study. As it is understood from the results of this research, if this study was arranged by one-tiered tests, it would be found that the results of misconception would be 73.4% for the first question, 93.7% for the second question, 85% for the third question and 59.5% for the fourth one. If this study was arranged by two-tiered tests, it would be found that the results of misconception would be 54.15% for the first question, 87.04% for the second question, 77.07% for the third question and 58.47% for the fourth one. In short, it was found that 77.9% of the students were mistaken in one-stage tests when the average of the four tests was taken into consideration. However, this result was also found as 69.18% with two-tiered tests and 24.23% with three-tiered tests. When the tables are examined carefully, there is just one person among 301 students (0.33%) who answered and explained his answer in the correct way and is sure about his answer especially to the second and fourth questions related to electrical current and sound. There are just six students who answered and explained correctly and also are sure about his answer to the third question in which the relation between frequency of light, wave length, refraction, dispersion and colour concept was questioned. These results have also shown that pre-service class teachers have lack of information in basic physics concepts.

DISCUSSION AND CONCLUSIONS

It was identified by this study - in which 301 pre-service class teachers chosen from various education faculties - that the students substantially have misconceptions in physics topics and also have much more lack of information. The reason of this could be thought as the students who study in classroom teaching department just take 2 physics course credits in total 156 course credits during their undergraduate education. It could be also associated that these students passed matriculation by their turkish mathematics points and they joined the science courses just during their secondary school years. This study has revealed that students’ wrong answers can not be related with the misconceptions they have and the true answers they gave to multiple-choice questions can not also be related with the knowledge they have about that matter, either. As the students could mark just the choices even in three-tiered tests, they could not explain their opinions enough. So, it is important that the misconception studies should be also supported by interviews. This study also supported the idea that it should be discussed whether the student selection examinations or the selection examinations in general choose the best person or not.

REFERENCES


