Prospective Science Teachers’ Misconceptions Concerning Wave Physics

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SYNOPSIS

INTRODUCTION

In the last three decades, studies on the conceptions of students and teachers on various science content domains and their roles in learning science have been one of the most important fields of research in science education. These studies show that pre-instructional knowledge or beliefs of learners about the phenomena and concepts to be taught are usually different from scientific knowledge and that these conceptions influence further learning and may be resistant to change; and what is more, teachers and prospective teachers as well as students have certain conceptions on the issue. There are many studies conducted to examine the conceptions in various domains of physics (mechanics, electricity, optics). Nevertheless, it is obvious that the amount of research on waves is strikingly scarce (see Pfundt & Duit 2007). Studies on students’ conceptions concerning wave physics show that students encounter difficulties in understanding this fundamental topic. These misconceptions could be briefly summarized as follows:

- Students seem to have profound difficulties separating the creation of a wave pulse from its propagation through the system. Students are using an impetus-like model to describe the movement of a wave pulse through a medium. For many students, the propagation velocity seems to depend on the wave pulse shape and the wave pulse length does not depend on the medium. Students tend to reduce the number of variables in propagation situations (Maurines, 1992).
- Students interpretations do not focus on the event nature of wave phenomena but on an object-like description and they seems to make an implicit analogy between the wave pulse and object like a ball (Witmann, Steinberg & Redish, 1999; Witmann, 2002).
- Students seem to have profound difficulties with the subject of the superposition of waves. The superposition principle cannot be applied unless the peaks of the pulses overlap. A wave pulse is described only by its peak point, and no other displaced parts of the system are superposed (Witmann, Steinberg & Redish, 1999; Witmann, 2002; Şengören, Tanel & Kavcar, 2006).

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PURPOSE OF THE STUDY

The aim of this study is to describe prospective science teachers’ (PST) conceptual understanding about basic wave phenomena and concepts. The waves are of importance, the concept of wave plays a critical role in the learning of topics such as mechanic-electromagnetic waves, sound, physical optics and quantum mechanics.

METHODOLOGY

The study was conducted on 53 PSTs from the Department of Science Education at Necatibey Faculty of Education in Balıkesir University. PSTs did not take any course on the research subject at the undergraduate level. The questionnaire that is used as data collection instrument consists of 5 open-ended questions. The first and last questions were adapted from the study by Wittmann, Steinberg and Redish (1999); whereas the 3 others were adapted from the study by Maurines (1992). The questions addressed the creation and propagation wave pulses on a string and the superposition of wave pulses. The questionnaire was scrutinized by specialists, each on physics and physics education. The questions were tested through a pilot study administered to 5 students and then applied after the necessary changes were made. Upon the analysis of the explanations and drawings provided by the PSTs, a distinction was made between those scientifically correct and incorrect at first hand. The scientifically incorrect explanations were then analyzed to classify into groups with different content and to determine the misconceptions pertaining to each particular concept or phenomenon.

FINDINGS

The results of the study indicate that PSTs have misconceptions regarding the basic concepts and phenomena of waves. Scientifically, the propagation characteristics depend only on the medium and not on the nature of the disturbance. The results indicate that students have difficulties with this idea. For many students, the propagation velocity depends on the wave pulse shape; the wave pulse length depends only on the source; the wave pulse amplitude depends on the medium; the wave pulse amplitude and frequency are proportional to the propagation velocity. Concerning the superposition principle, wave superposition occurs by adding individual displacements point by point at any given time. But, students view to superposition as the addition of the maximum displacement point only and not as the addition of displacement at all locations. Among these misconceptions, in addition to those consistent with findings of the literature, there are also ones, in our knowledge, identified for the first time.

CONCLUSION

The PSTs constituting the sample group of this study did not receive any education about the subjects of waves at the undergraduate level. Yet, studies conducted on the samples consisting of students receiving a typical education at the undergraduate level display similar results. It is a question of importance the lack of and necessity to develop educational materials to be prepared for every educational level in the framework of constructivism taking into account the background of students, aiming at bringing about and facilitating a conceptual change in order to achieve scientific conceptual understanding. Given that the sample group of the study will be teachers in the future, educational approaches and materials which would provide conceptual understanding are increasingly becoming more important in undergraduate level education. As for the wave physics, there is the need for further studies on conceptions for every educational level.
REFERENCES


