

Peer Instruction and Students' Understanding of Physics

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Abstract. Peer Instruction is an interactive teaching method developed by Eric Mazur in the 1990s to improve learning in the introductory physics courses at Harvard. It has been adopted across disciplines and universities and high education institutions around the world. This method improves students' understanding of physics and helps overcome their misconceptions. In the article, history, experience and results of Peer Instruction will be described as well as plans how to use it at Czech schools.

Introduction

Students' understanding of basic physical concepts is a much discussed topic nowadays. An interesting view on students' preconceptions and misconceptions is described for example in the book [Mandíková, 2011]. How can teachers help their students and pupils overcome their misconceptions? One of the effective ways is the Peer Instruction teaching method. The efficiency of this method is described in [Crouch 2001, Fargen 2002].

This article presents basic information about the Peer Instruction teaching method developed by Eric Mazur in the 1990s. The history of the method and some reasons why the method was developed are mentioned. Peer Instruction is based on posing questions (Mazur calls this question ConcepTest). Using these questions in the Peer Instruction method during a lecture is described as well.

During the next year the first use of teaching by the Peer Instruction at Czech schools will be observed. A group of teachers will try to implement this method in teaching of physics at some secondary and high schools. Case study of this implementation is described in the part "Plans to explore possible implementation of Peer Instruction in Czech schools."

History of Peer Instruction

The Peer Instruction teaching method was developed by Eric Mazur in the early 1990s. Eric Mazur taught introductory physics courses the traditional way at Harvard University until that time. His lectures were interesting, he prepared a lot of classroom demonstrations for his students and they gave him a nice evaluation at the end of each semester. So, why did he decide to create new method?

Force Concept Inventory (FCI), the diagnostic instrument of students, testing understanding the most basic concepts in Newtonian physics was presented by Ibrahim Halloun and David Hestenes and first articles about students' misconceptions were published. Using FCI Mazur realized that even his students with good final results had a lot of misconceptions.

Using the new teaching method Mazur converted his lectures completely. Main points of his new method were questions and communication between students. He started to create ConcepTests, questions focused on basic concepts (more information about Concept Tests in the next paragraph), he prepared texts for students to read before lesson (Just in Time Teaching). Students had to read some information about new topics before lesson and they had to answer basic questions about new concepts. When they came to the lecture, Mazur knew how students understand new concepts and what they should improve. During the lecture they were focused on the most problematic parts of the topics.

ConcepTest

Instead of describing the topics (presenting from the textbooks) by the teacher, Peer Instruction is based on discussing and answering questions. Lectures consist of short presentations of key points followed by a ConcepTest.

A ConcepTest is a short conceptual question on the subject being discussed. This question could be multiple choice with one (or more) correct answers and other options which are the most common misconceptions on the subject. More than 200 ConcepTests are in the book *Peer Instruction Manual* [Mazur, 1997].

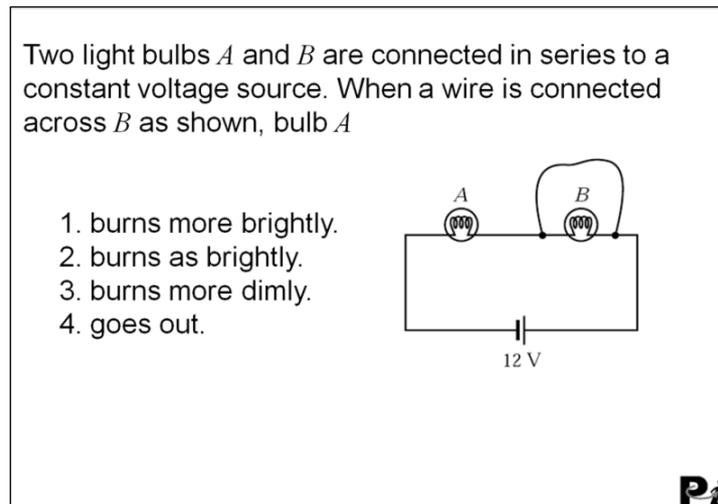


Figure 1. An illustration of the ConcepTest on DC circuits, from the book *Peer Instruction: A User's Manual* [Mazur, 1997].

Students could show their answers to the teacher using flashcards or an electronic classroom response system. In [Lasry, 2008] are presented findings that from the learning perspective there is not a significant difference between using flashcards and an electronic system. From a teaching perspective, the electronic system has some very practical advantages, for example precise real-time feedback. Nowadays students use modern web-enabled devices — laptops, smartphones or tablets in everyday life. Engaging students using their own devices could be the best way in the future.

Implementation into the lecture

Students are required to read the lecture notes and textbooks before coming to class. The lecture consists of a number of short presentations on key points followed by a ConcepTest. In the beginning the teacher gives the students basic information about the new concept. Then the teacher shows the question. When a ConcepTest is posed, students have a short time to think about the right answer. Then they answer the question. If there are enough right answers in the class (30–70 %) students start to discuss their answers with their neighbours. After peer discussion students show their answers a second time. In the end there has to be the explanation of the correct answer. More information about using the method is described in [Mazur, 1997; Koncelova, 2011].

Researches show that during the second response on the same ConcepTest students chose correct answer more often than during the first response [Crouch 2001]. They teach and learn among themselves in the group.

Plans to explore possible implementation of Peer Instruction in Czech schools

Within the research project Interactive Instructional Methods of the Peer Instruction Type and the Exploration of Their Implementation in Physics Education supported by The Charles University Grant Agency (GAUK) a case study on implementation the Peer Instruction method into the Czech secondary and high schools will be realized next school year. A group of teachers will use Peer Instruction during their physics courses. They will use ConcepTests from the book [Mazur, 1997] and original ConcepTests prepared according to the study of misconceptions from the book [Mandíková, 2011]. Even though the book [Mazur, 1997] contains ConcepTests originally prepared for university, these questions are based on basic concepts which could be taught at high or secondary school in the Czech Republic. This statement was verified by the author of the article during the teaching physics courses at the Lingua Universal secondary school (Litomerice, Czech Republic) during the last three years [Sestakova, 2012].

A user's manual of Peer Instruction in the Czech language will be created during next school year as well as the first database of ConcepTests in Czech language.

Conclusion

The understanding of physics could be improved by using active teaching methods. According to the research [Crouch, 2001] Peer Instruction improves students' understanding of physics significantly better than traditionally taught courses. This finding could be an inspiration for our universities. Some ConcepTests from the book [Mazur, 1997] are based on basic concepts which could be taught at high or secondary school in the Czech Republic. Another new ConcepTests will be created according to the study of misconceptions from the book [Mandíková, 2011]. During the next school year a group of teachers will be involved in a case study of implementation Peer Instruction to physics education at Czech schools.

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