RECENT DISSERTATIONS

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Improving the learning of thermal physics at university.

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Abstract

This dissertation addresses university students' conceptions concerning thermal physics in introductory-level physics courses. The aim of the study has been to improve learning about the essential thermal physics content by means of a lecture-based teaching intervention.

The principal aim of the research has been divided into three sub-aims related to students' conceptions in different phases of the studies: (a) prior to instruction, (b) following conventional lecture-based teaching, and (c) during and after the teaching intervention. Data was collected with the aid of paper-and-pencil tests, interviews, and audio recordings.

Prior to the start of instruction, students harbored various misconceptions. They did not distinguish concepts and they did not seem to understand how work relates to thermodynamics. This insight was reinforced when students' explanations concerning adiabatic compression of an ideal gas were evaluated: students relied on the ideal gas law and microscopic models instead of work and the first law of thermodynamics. It was also revealed that students were oblivious of the inconsistencies in their reasoning.

Conventional lecture-based teaching left students with various misconceptions. A majority of them had various problems concerning the process quantities of heat and work. Other misconceptions were observed: the impact of work on internal energy was ignored, processes were not distinguished, and the interdependencies for quantities were misunderstood. One prevalent problem was the absence of students' use of pV diagrams.

Inspired by these findings, a teaching intervention was constructed to supplement the conventional teaching. The intervention is based on scaffolding, which refers to the processes whereby the learner is helped in completing otherwise unachievable tasks. In the present study, scaffolding was implemented in the form of content hints and peer discussions. To this end, the intervention consisted of four phases: an individual working phase, two hinting phases related to physics content, and a peer interaction phase. The intervention took place in the lecture setting after the necessary content had been introduced.

The intervention helped students to achieve a better learning outcome, the real change being statistically significant in most of the tasks. Compared to previous studies, our intervention produced a 15-20 percentage point enhancement in the learning outcome. We also observed a reduction in the percentages of misconceptions, with some exceptions. Similar follow-up results in the post-testing showed that the impact of the intervention was not short-lived.

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