Junior high school physics: A new approach for qualitative explanation of phenomena

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Students and science teachers at the junior high school (JHS) level often cannot use their knowledge of physics for explaining and predicting phenomena because they lack qualitative understanding of the domain.

The main goal of this thesis has been to start a process of change that might allow JHS students and teachers to enjoy the beauty of physics by placing the development of qualitative understanding as a central goal of JHS physics.

Following a preliminary study, we hypothesized that achieving qualitative understanding is a multi-step procedure that requires a conceptual framework and a qualitative problem-solving strategy that would guide students to use the concepts correctly.

The thesis describes the development, implementation and assessment of a new instructional approach that integrates the conceptual framework and a new qualitative problem-solving strategy that uses visual representations extensively.

The research included (1) *a diagnosis* of reasoning and qualitative problem solving skills of students (n=480) and JHS science teachers (n=32) who were taught according to traditional instruction in the domain (2) *an assessment* of the new approach and its influence on students in achieving qualitative understanding in the domain (n=310), (3) *an assessment* of students' views and attitudes toward the new approach (n=180), and (4) *an assessment* of the changes in teachers' views and confidence to teach physics following a workshop that is based on the new approach (n=92).

The research instruments included content and attitude questionnaires, classroom observations and interviews.

Results show that Israeli students, after traditional instruction, had difficulties in solving qualitative problem and demonstrated similar misconceptions as their fellow students worldwide. However, JHS students who studied according to the new approach, advanced significantly from pretests to posttests both on the well known qualitative questionnaire (FCI) and on understanding performances that were defined according to our learning goals and the relevant facets defined in the literature.

Other results show that introducing the approach to JHS science teachers developed their qualitative understanding and that their confidence to teach physics increased.