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Physics education research as a guide for improving the teaching and learning of physics: an example from optics

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Abstract: The Physics Education Group at the University of Washington has been investigating student understanding of geometrical and physical optics. The results of this research have guided the design of two curricula. Examples will be given of serious student difficulties and how they are addressed through these research-based curricula.

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The Physics Education Group at the University of Washington has been investigating student understanding of optics. Findings indicate that many students who have studied physics at the introductory level and beyond cannot apply basic principles from geometrical optics to account for the pattern produced when an aperture is placed between a light source and a screen. Identification and analysis of student difficulties have guided the design of two curricula: one to supplement instruction in lecture-based university courses (*Tutorials in Introductory Physics*) and one for the preparation of pre-college teachers (*Physics by Inquiry*). Ongoing assessment was an integral part of the curriculum development process. The instructional materials that evolved from this iterative cycle have proved to be effective with the target populations. In addition, with appropriate preparation, pre-college teachers can effectively adapt the materials for use in their own classrooms.

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