

Student Learning In Upper-Level Thermal Physics: Comparisons And Contrasts With Students In Introductory Courses

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Abstract. We found that students in an upper-level thermal physics course were in general quicker than introductory students at grasping and applying fundamental concepts. Upper-level students seemed, in general, more receptive to employing qualitative reasoning using multiple representations, and capable of using it more effectively than introductory students. In addition, upper-level students were better able to utilize guided-inquiry curricular materials in the sense of reasoning with greater depth and grasping more subtle issues. However, although the overall level of preparation and ability was higher in the upper-level course, the broad range of preparation represented among the students presented various practical challenges to implementing active-learning instructional strategies. Moreover, even quite capable upper-level students would falter unexpectedly and unpredictably on various conceptual difficulties that are common among introductory students. The unpredictable and inconsistent nature of this effect demonstrated that instructors must always be prepared to detect and address such difficulties in upper-level courses.