

**article:1259****Developing On-Line Homework for Introductory Thermodynamics**

Beginning in Fall of 2001 to the present, the authors (EEA and MPS) incorporated on-line homework into introductory thermodynamics at Texas Tech University and the University of Wyoming. The homework sets were composed by one of the authors (EEA) to cover critical topics in the first ten chapters of the course textbook [1]. Multiple homework sets were often available for the same topic, which meant that repeating a topic could provide meaningful practice for a student. Over the course of a semester, students were assigned roughly 25-35 homework topics; completion of these homework sets constituted less than 10% of their final grade. The instructional goal was to provide students with brief developmental exercises throughout the semester in order to review essential concepts and procedures and to prepare students for in-class evaluations.

The homework problems were made available to students over the World Wide Web. Each time students accessed the problems, their interactions were automatically recorded and stored on the computer server. The data in this paper are from the final semester in which we tracked students, a point at which the software had been refined and fully implemented into the course curriculum. We used the automatically-generated computer records (time-stamped key strokes and click trails) to answer three practical questions about the usefulness of the on-line homework to student learning: i) How much time did students spend doing on-line homework? ii) How did students' incorporate on-line homework into day-to-day academic activities? iii) Did doing on-line homework improve in-class test performance?

The first question was related to an ongoing interest in determining how students distributed total study times among multiple available learning resources [2]. The second question focused on when students completed the on-line homework problems—i.e., in a regular manner throughout the semester or, conversely, immediately before tests; also, whether students repeated homework topics, which was allowed, or simply completed a homework topic once, in order to fulfill the basic homework assignment. Finally, the third question was based on the importance of active learning [3] and 'time-on-task' [4], and prior findings supporting correlations between time on task and in-class test performance [5].

The on-line homework was designed to provide students with quick and accessible exercises related to current course topics. The data showed that students were able to complete the exercises with high scores and without an excessive allocation of time. Students completed homework in a regular manner throughout the semester, which we verified by examining the computer records. Students did not repeat homework topics, even though they could have done so for additional practice and feedback. The correlation analyses showed that completing online homework was associated with higher grades on in-class tests.

The correlations between on-line homework and test performance that were revealed through this research support the utility of on-line homework. The positive correlations are also consistent with a general theory of time-on-task [5]. This analysis of on-line homework is a good complement to other research [2] that we conducted with students from this population in which we examined how completing on-line homework fits in with other study behaviors students engaged in. Clearly the generalizability of these results will depend on further replications with larger sample sizes, as well as comparisons to control conditions in which students do not have access to online homework. Further, more detailed knowledge of students' cognitions, motivations, and affective responses as they worked through these homework sets would further our theoretical understanding of the psychological impact that these homework lesson have on students, and would provide valuable insights into how to modify and improve the homework activity. Finally, collecting data in classrooms introduces many uncontrolled variables and potential confounds to the observed effects.

## References

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