Evaluation of a Multimedia Program Designed to Engage Students in Scientific Inquiry

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Abstract: Multimedia software that is intended to support science education reform must be designed so that teachers can successfully adapt it to their local circumstances. This short paper describes efforts at the NASA Classroom of the Future (COTF) to develop techniques for evaluating the extent to which teachers can successfully adapt its multimedia software.

Introduction

Over the last century science educators have tried repeatedly to reform science education. From decade to decade the goal has been the same: to help students engage in scientific inquiry and cease being passive receptors of information. In every era of reform there have been pilot projects that have successfully engaged students in scientific inquiry. In those pilot projects students learned more and developed healthier attitudes toward science than did students in traditional science classrooms [Shymansky, Kyle, & Alport, 1983]. However, those projects have not become the norm in spite of their promise. Actual classroom practice has remained intractable. Researchers have observed that despite outward appearances, what actually goes on in today's science classrooms remains strikingly similar to the rote practices of the nineteenth century [Bybee & DeBoer, 1994]. Why has it been difficult to extend science education reform beyond the successes of a handful of pilot projects?

According to Cuban [1993], reform efforts often fail to sustain at the classroom level because they largely ignore the inevitable fact that the reformed curricula provided to teachers must be adapted. In their efforts to accommodate the often conflicting demands of many constituencies such as school boards, administrators, parents, and students, teachers cannot use all instructional techniques and materials exactly as intended. Real-world constraints necessarily factor into how teachers implement reform in their classrooms. Teachers are forced to become instructional designers, making decisions about what features of the reform to preserve and what features to adapt. However, if teachers make the wrong adaptations, if they overlook or distort the critical elements of the innovation, not only will students fail to engage in scientific inquiry, but the entire reform movement itself will be judged by the failed implementations. Therefore, it is essential for multimedia designers to investigate how teachers can successfully adapt the software for use in their classrooms.

This paper reports on preliminary results from a pilot evaluation of the *Astronomy Village*® multimedia program developed at the NASA Classroom of the Future (COTF) program. *Astronomy Village* presents a virtual mountain-top observatory interface from which students investigate contemporary problems in astronomy [see Pompea & Blurton, 1995 for a description]. After selecting one of ten investigation pathways, students are guided by talking, virtual mentors through the steps of scientific research: background research, data collection, data analysis, data interpretation and presentation of results. The software is intended to help teachers support students at engaging in scientific inquiry. The goal of the evaluation efforts being conducted by the author is to understand the variety of ways that classroom teachers can adapt *Astronomy Village* to engage students in scientific inquiry. For his research on *Astronomy Village*, the author has adopted "academic tasks" as a theoretical perspective for investigating the intersection between teaching and learning [Doyle 1983]. An academic task is defined by the goals that students are expected to accomplish, the resources that are available to students while they are pursuing the task goals, and the operations that students can use in manipulating the resources to accomplish the task goals. Teachers will be able to successfully adapt *Astronomy Village* if they can design academic tasks in which students use the software as a task resource to achieve the task goal while employing operations that mirror scientific inquiry. In order to investigate the ways in which teachers can adapt *Astronomy Village*, it is necessary to develop techniques for determining the extent to which students achieve a task goal and the extent to which the students' task operations reflect scientific inquiry.

Evaluation

Thirteen students from the freshman class of a local girls academy served as the pilot study population. The students came to the COTF test facility in lieu of their science class every day during a four-week period (April-May, 1996). The unit that involved the use of the *Astronomy Village* was co-taught by the author and the students' classroom teacher. The academic task goal that the teachers defined for this evaluation was that students conduct each and every activity that the virtual mentor suggested for each of the phases of scientific research. As part of that task goal, students developed an activity summary for each activity in the LogBook provided by the software. The activity summary consisted of a brief description of the activity, a statement of how the activity related to the main research question, and any new questions that arose from the activity. Thus, the activity summaries served as a record of what students were able to accomplish.

Conclusions

The overall evaluation will investigate both students' ability to accomplish the *Astronomy Village* academic task goals and the extent to which the operations that students used mirrored the process of scientific inquiry. However, the data analysis for this short paper focuses on techniques for measuring the extent to which students accomplished the academic task goals. The number of activity summaries that students developed was divided by the number of activities that the mentor suggested in order to determine the task completion rate. The task completion rate can be used as a measurement technique for determining how closely students achieve an academic task goal. The average task completion rate for this study was 42%. This value indicates that over the four-week period, students completed less than half of the activities that the mentor suggested. An analysis of the task completion rate within each phase of research (background research - 55%, data collection - 75%, data analysis - 35%, data interpretation - 20%, and presentation - 27%) revealed that the task completion rate was much lower during later phases of research. Based on the poor performance of the students, the *Astronomy Village* academic task structure is being modified to improve students' ability to accomplish the task goal. For example, students should be given deadlines for each phase of research so that they will have sufficient time to complete later phases of research. The task completion rate is only one technique that can be used to evaluate the ways in which the software and/or task goals need to be modified. Subsequent analyses will help identify techniques for measuring the extent to which the task operations mirror the process of scientific inquiry.

References

[Bybee & DeBoer, 1994] Bybee, R. W., & DeBoer, G. E. (1994). Research goals for the science curriculum. In D. L. Gabel (Ed.), *Handbook of Research on Science Teaching.* New York: Macmillan Publishing Company.

[Cuban 1993] Cuban, L. (1993, October). *The lure of curricular reform and its pitiful history*. Phi Delta Kappan, 182-185.

[Doyle 1983] Doyle, W. (1983). Academic work. *Review of Educational Research, 53*(2), 159-199.

[Pompea & Blurton, 1995] Pompea, S. M., & Blurton, C. (1995, Jan-Feb). A walk through the Astronomy Village. *Mercury*, 32-33.

[Shymansky, Kyle, & Alport, 1983] Shymansky, J. A., Kyle, W. C., & Alport, J. M. (1983). The effects of new science curricula on student performance. *Journal of Research in Science Teaching*, 20(5), 387-404.