Example from a Framework for Future Learning Environments: Human Factors and Learner Engagement in Collaborative Workspaces with Tablet Computing

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Abstract: This research centers on a design to elevate learner engagement or immersion in mathematics classrooms in order to optimize students' mathematical growth. The design's theoretical logic is related to eight principles for future learning environments, and to an interpretation of engagement as recruitment of attentional, perceptual and complex reasoning resources.

Introduction

Previous research based on self-reports by mathematics students at the high school and college level suggests a perception by students that upwards of 80% or more of the time that they are in mathematics classes does not involve substantial mathematical cognition. These figures are average values; for many students, the percentage of time they self-reported as disconnected from mathematical activity during class time approaches 95% or more. Although disengagement and its causes are multi-factored and complex, student explanations accounting for disengagement include confusing instruction, general boredom or distraction, and a sense that the class topics are too difficult, too easy, or meaningless.

The ascendancy of learning science research and its visibility in addressing enduring problems in education is a promising development in the past decade. How learning science contributes to the problems of traditional classroom environments is crucial to next generation educational environments. One such problem is the productivity of class time. The research discussed in this poster discusses investigations in promoting routine and productive engagement in mathematics classrooms. More specifically, it focuses on a design to recruit learners' attentional, motivational and complex reasoning resources in order to optimize their mathematical growth during classroom instruction. The design involves a blend of tablet computers with collaborative workspaces to promote deep immersion or engagement by learners in classroom mathematics.

Intervention

Four distinct instructional intents guided the iterative design of the intervention. The design intents were met with the hardware and software technologies including TabletPCs (hardware), notebook software to prepare, store and retrieve handwritten material (WindowsJournal) and collaboration software (SynchronEyes from Smart Technologies). The products work well, though this research is not product-specific but rather is organized around the functionalities they represent and the ways in which the functionalities enhance each other. For the purposes of this paper, the combination of these technologies is referred to as the SynchronEyes x Tablet treatment.

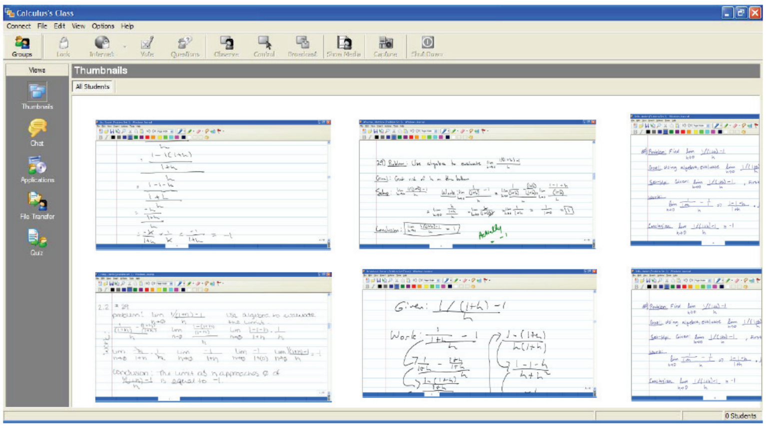

Figure 1. Screenshot View of Student Screens from Teacher Screen.

Instruments and Measurement and Results

Is this design associated with higher levels of engagement? Students in the comparison group self-reported either full or deep engagement with a PDA form of Experience Sampling Method (ESM) in 52% of the polled events. Students in the experimental group self-reported either full or deep engagement in class activities at a

67% rate. A straightforward z-score computation supports a statistically significant difference at the .005 level. These results were supported by independent classroom observations during each of the PDA-ESM class sessions, and by interviews with the participating faculty. The data tend to confirm underlying conjectures about the value of rapid and precise feedback loops in promoting learner engagement, permitting the teacher to adjust questions or task parameters in adaptive response to student needs.

Table 1: Eight Principles of Future Learning Environments (Expansion of principles originally appearing in (Hamilton 2006; Hamilton in press).

1. **Increased sightlines in the classroom** – greater ability for everyone in a classroom, teachers and students alike, to see conceptual models others are using in the classroom; content, cognition and affect become more visible.
2. **Increased emphasis on models and modeling** – a greater stress on systems of ideas and relationships both in how learning "tasks" are structured and in how assessment is carried out; connections and the structure and relationships of ideas becomes as salient as ideas;
3. **Increased connectedness** – individuals become more meaningfully connected in the learning experience to each other, to teachers, and to those outside of the classroom;
4. **Increased "one-to-one-ness" in the classroom** – a greater sense of individualization and customization for the individual learner under the management of a teacher, emulating a one-to-one tutoring experience.
5. **Increased fluidity of learning context** – transfer to and from virtual systems, greater emphasis on heterogeneous competencies functioning together, greater integration of cognitive, social and affective dimensions, more interoperability of individual-social-machine knowledge forms; a principle of "hybrid" modes of learning modes and content.
6. **Increased emphasis on generativity and creativity** - Learners function in more imaginative settings in which they are able to be more imaginative
7. **Increased emphasis on self-regulatory competencies** – Learning environments will increasingly offload onto students tasks previously carried out by teaching professionals. Teaching professionals will then engage more sophisticated competencies and skill sets.
8. **Increased interactional bandwidth** – the capacity of the learning environment to mediate meaningful content and affective representations that are shared by all participants.

Descriptive Framework for Future Learning Environments

This research contributes to and relies on an evolving framework that describes key characteristics or principles of future learning environments. The framework invokes multiple theoretical perspectives and suggests that future learning environments will feature combinations of these characteristics or elements to produce synergies or compounds that have unique affordances for learning. Table 2 lists eight principles. Each in some fashion can enable, propel or be enabled or propelled by the others. Each represents, on a standalone basic, salient features of promising environments of the future. While it is outside the scope of this poster to elaborate fully on the types of synergies that combinations of these principles might afford, the design studied in this project can be expressed as a combination of several of them, and that combination is discussed as a means to illustrate the overall framework.

For example, the first characteristic, of greater sightlines, is the most salient feature of the intervention. One primary sightline advantage for the teacher is the capacity to see, on demand and without cueing the students, the mathematical workspace of any student or all students. The display in Figure 1 illustrates one screenshot from a class involved in the intervention. The teacher can scroll through the display and observe students work in real-time. The sightline provides the teacher an opportunity to minimize distracters to viewing student mathematical models. The second principle, of increased emphasis on modeling, can be instantiated by the fact that a teacher can view not only individual answers (such as with clickers or in calling on students during a class session) but, at the least, can see a flow of ideas as they are reflected in student writing. The poster includes a cross-walk illustrating how all eight principles are instantiated through this approach.

References

Hamilton, E. (2006). International collaborations blending new pedagogies and new technologies in engineering education: principles and examples. Fifth Global Colloquium on Engineering Education, Rio de Janeiro, American Society for Engineering Education.

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