Work in Progress - Can the Tablet PC Provide “New Opportunities to Learn?”

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Abstract - With the advent of the information age, engineering educators have struggled to change pedagogical practice to prepare students for the pace and complexity of the world ahead. Constructivist instructional methods are particularly promising because they explicitly promote active evaluation of information and higher-order thinking, and encourage faculty to act as a facilitator of student learning. The Tablet PC is a potentially valuable tool in this instructional environment because of its wide-ranging functionality. In the present study, we examine the unfolding effects of a large-scale Tablet-based deployment at a R1 College of Engineering. We employ pre and post measures to evaluate students’ (1) attitudes toward technology, (2) technology use, and (3) metacognitive strategies and motivation. Initial results also show some significant cognitive effects in courses using the Tablet. With course implementations underway that make fuller use of Tablet capacities we anticipate more positive learning outcomes.

Index Terms – Tablet PC, constructivism, metacognition.

Several decades after instructional technology was introduced to collegiate teaching, its impact remains promising but inconclusive. While proponents of technology initially touted its efficiency and cost effectiveness, more recent arguments focus on its ability to deliver a high-quality teaching and learning environment. In particular, many argue that new technologies can promote a more robust pedagogy based on empirically proven constructivist practices that better scaffold student learning [1,2,3]. Constructivist instructional methods are particularly promising because they explicitly promote active evaluation of information and higher-order thinking, and encourage faculty to act as a facilitator of student learning rather than as content provider [4].

Perhaps because of the obvious compatibility between new technologies and new pedagogies, researchers’ assessments have often confounded implementation of a technical tool with the curriculum and/or pedagogy in which it is embedded. [1]. The negative findings which dot the landscape of the literature are thus hard to interpret as they may signal a failure of technology, a failure in instructional delivery or, perhaps most likely, a mismatch between the two. While there is evidence to suggest that new technologies can change the teaching and learning process, it is unlikely that the “affordances” of new technologies—and their interactive, visual, collaborative and organizational features—will be optimized in a traditional, didactic college classroom. In fact, when new technologies are simply appended to old teaching methods, there is a tendency for the instructor to push information out to students even faster and to reduce time for discussion and reflection [6].

At Virginia Tech, the College of Engineering’s decision to require all 1200 incoming freshmen to purchase a Tablet PC offered us a unique opportunity to study the unfolding effects of a new technology on teaching and learning. The Tablet PC offers its own promise and perils as the wide-ranging functionality of the Tablet makes it among the most flexible of instructional tools and also therefore one of the most difficult to assess. We felt, however, that by wedding contemporary learning theory to the varied functionality of the Tablet PC, we could test Tablet-based instructional innovations in a way that would help more decisively calibrate the impact of technology on student learning.

The present research began with a clearly articulated set of links between specific capacities of the Tablet PC and specific metacognitive and cognitive outcomes suggested by the literature [3,5,7] (Figure 1). Research has emphasized the particular potential that computer technologies have for developing students’ metacognitive skills and encouraging the more self-regulated learning that is prerequisite to mastery of conceptually rich domains like engineering. Metacognitive activities enable students to self-consciously attend to their own internal learning processes and in so doing make them better able to: (1) set learning goals, (2) employ learning strategies to achieve these goals and (3) monitor their comprehension and achievement. Demonstrating the value of new technologies such as the Tablet PC to metacognition and learning has been hampered, however, by “the lack of theoretical and empirical evidence necessary to advance research on open-ended electronic environments” [5]. We thus constructed a working theoretical model to guide and integrate the different components of the research that will span the next several years (Figure 2).

Global effects of the Tablet PC are evaluated through a set of measures administered longitudinally, on-line, to all engineering faculty, and a subset of 400 students over the first several years of the deployment. At present, we are administering a baseline measure to faculty assessing
general pedagogical practice and use of instructional technology. We are also currently completing collection of a second wave of data with 425 students. This collection evaluates Tablet utilization and attitudes towards instructional technology (including items from a national ECAR study). Metacognitive skills are measured using the established Motivated Learning Strategies Questionnaire.

General measures are augmented by course-specific evaluations which examine different dimensions of Tablet functionality using additional pre- and post- measures and experimental and comparison groups of students in a quasi-experimental format. For example, in a course taught this semester on mechanical engineering design, one section of the class is being taught with the Tablet, the other section taught without it (by the same faculty). The Tablet section uses classroom presentation software to: (1) make lectures more dynamic and interactive and (2) as a vehicle for collaborative group work inside and outside class. In another course on electrical engineering, both sections are again taught by the same faculty, but in one section the Tablet is used exclusively by the faculty in-class and in the other by both faculty and students. Students in both courses were administered the same set of measures at the start of Spring 2008 as were administered to the larger cohort of 425 students. These same measures plus a Constructivist Learning Environment Survey will be re-administered imminently as a post-test, and we will obtain students’ grades from official records.

Findings are obviously preliminary at this stage and are drawn from the responses of the subset of students from the initial Tablet cohort. This group of participants report technology skills comparable to a national sample. Students with weaker perceived skills (women are among these) are more reluctant about classroom technologies and want more training before technologies are implemented. Despite this, actual Tablet use did not show significant differences in amount or type of use by students’ technological competence, with about 85% using their Tablet frequently. Open-ended comments suggested further that technical and logistical problems diminished substantially over the course of a single year but that about a third still feel the technology often does not work properly. Students using the Tablet courses reported using significantly less rote memorization to study than in high school and using higher-level organizational strategies significantly more.

Comparing classes with the Tablet PC to those without, students report that Tablet courses: result in more rapid memorization to study than in high school and using higher-level organizational strategies significantly more.

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<table>
<thead>
<tr>
<th>Tablet PC Function</th>
<th>New opportunities to learn...</th>
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<tbody>
<tr>
<td>Electronic notes</td>
<td>active elaboration and integration of concepts, organization</td>
</tr>
<tr>
<td>On line collaboration</td>
<td>teamwork, goal setting, tactics and strategies, monitoring</td>
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<tr>
<td>Multiple-representational modes</td>
<td>textual, symbolic, spatial, textual representation, comprehension, tactics and strategies, monitoring, divergent thinking</td>
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<tr>
<td>Interactive classroom presentation</td>
<td>tactics and strategies, monitoring, critical thinking and problem solving</td>
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<tr>
<td>Ready access to internet</td>
<td>just in time information, organization, critical thinking &amp; autonomy</td>
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<td>Ready access to database, statistical</td>
<td>scales thinking e.g., through computational software</td>
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<td>design and other software</td>
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**FIGURE 1**
CONNECTING THE TABLET PC WITH CONSTRUCTIVIST LEARNING THEORY

**FIGURE 2**
THEORETICAL MODEL

REFERENCES


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