A SURVEY TO ASSESS THE IMPACT OF TABLET PC-BASED
ACTIVE LEARNING:
PRELIMINARY REPORT AND LESSONS LEARNED

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1. ABSTRACT
In this work we report on a preliminary survey to assess the impact of active learning using
the Ubiquitous Presenter (UP) system on students’ approaches to learning and valuation of
various ways to spend class time. We report on pre- and post- test results from four higher
education institutions in computer science and physics classes, half using active learning (AL),
half not. Overall, we show little change in student pedagogical viewpoint – and some change is
not in the direction we would hope for. We reflect on the pitfalls of our survey design and the
realities of whether we should expect to change student pedagogical viewpoints in one term. We
seek input in the form of discussion on our collective expectations for pedagogical shift in a
higher education student body.

2. PROBLEM STATEMENT AND CONTEXT
There is considerable evidence to suggest active learning (AL) can lead to increased student
learning [1], and many Tablet PC tools exist to facilitate engaging students in various forms of
AL in the classroom. Further, one might expect the use of AL to impact students' views about
learning. Instructors who use these systems often report student satisfaction anecdotally and
through surveys. However, it can be very difficult to set up a controlled experiment to assess the
educational impact of Tablet PC-based active learning systems as in [2]. We sought to develop a
discipline-neutral pre- and post- survey that would assess the impact of an active learning-
focused class on student approaches to learning and on student valuation of beneficial use of
class time. Our goal was to develop a set of items that could be used in any discipline, across a
range of AL-supporting systems, and in non-AL classes (as a baseline). We hoped to see
changes on a per-student basis from the pre-test to the post-test as those students in active
learning classes come to value a more constructivist approach to instruction and learning.

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Operating within a social constructivist perspective, we identified learning principles that
we hoped students would come to value through their experience with AL. These learning
principles include the idea that knowledge is constructed gradually in a complex process [3,4]
and that students’ learning is mediated by social interactions [5]. We developed a 26 item on-line
survey with 12 items on approaches to learning and 14 items about class meetings or lectures.
Additionally, on one item students were instructed to pick a particular response – in order to
eliminate results from students entering answers without reading the items. Each item could be
answered from 1-5 on a Likert scale ranging from agree, agree somewhat, can’t decide, disagree somewhat, disagree. Additionally, students could answer “irrelevant to me” or “don’t know”.

Many student approaches to learning items were adapted from the ASSIST survey [6]. Items cover topics such as textbook reading practices, use of sample solutions, interacting with other students, learning as facts and information, getting feedback, and the purpose of notes. The items on class meetings/lectures cover a variety of constructivist learning experiences including five items on what it is valuable to spend class time doing.

4. EVALUATION
We deployed the survey in four classes at four institutions as described in Table 1. In the “A” courses, active learning was used heavily; four to six AL items were asked each day and traditional “lecture” was less than 10% of class time. All students were given a point for completing the survey in the first week of class and again in the last week of class. Validated answers were matched across pre- and post- tests to allow per-student analysis. We measure per-student change in beliefs in one of two ways: if a student switched from an “agree” (1 or 2) answer to a “disagree” (4 or 5) answer or vice versa.

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Change Across All Classes. After a term of study of beginning physics or computer science, more students found it more useful to study a correctly worked solution than to try a problem themselves, a result that seems disappointing from a strictly constructivist perspective*. Upon reflection however, we recognize that valuation of this item may depend on context. We further discuss survey development and validity in section 4.2.

We asked if students found value in reviewing the work of others outside class – something supported through UP’s web-based interface. Earlier UP surveys had noted that up to half of students did this, but evidence of why this behavior occurred was mixed – some reviewed for exams, some said they just wanted to see what others put down. We hope students would critically evaluate others’ work, and thereby develop their own analytical skills. Students may not have shared this intention; we note anecdotally that students greatly value our marking of student submitted answers in UP as correct or incorrect. They show significant concern about possibly

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Change in active learning in Physics. In just the physics active learning class, we see two items with positive results that show opposite change in the other three classes. Only in the physics active learning class do more students switch to disagree with the value of memorizing sample problems and fewer report that they often just go through the motions when they are studying. Disappointingly, we see note-worthy movement in the opposite direction in all the other classes. Oddly, 19% more of students in the active learning physics class felt that learning facts and information was “enough” at the end of the term. We are unsure why this is the case, but perhaps despite the problem solving-oriented nature of the class, by the end students are overwhelmed and resort to memorizing strategies.

Survey Development and Validation

We identify several issues that need further study regarding validity. The first concerns how students interpreted the items – was our wording too “pedagogical” for students? Did they interpret terms in the same way we intended them? Interviews with students can help develop unambiguous wordings and are currently being conducted.

Second, for some items, the favorable answer (the one consistent with the learning principles we hope students to value) is not well defined – it may depend on context or intent. For example, we ask whether studying a correctly worked problem is more valuable that trying one on your own. From a constructivist perspective, trying to work a problem on your own is a valuable way to build understanding. But we can imagine situations where reviewing a clear, concise, known to be correct solution would be more valuable. For example, when we asked about “studying” it is quite possible students thought of themselves reviewing for an exam – perhaps a time better engaged in solidifying understanding than constructing new understanding. A better wording might have used the term “learning about a new subject”. Even then, perhaps this item still doesn’t determine if students recognize that attempting to construct their own understandings through trial and error is of value.

In two items on the value of “notes” and “notetaking” the affordances of UP itself cloud item interpretation – at least in a post-survey. It may be that students find that the instructor’s ink on slides is a “record of what the instructor said” and therefore, is no longer good material for personal notes – it’s on UP. However, another interpretation has the students interpreting “notes” as not only their own notes, but also what the instructor “noted” in ink. It is possible, then, that as students observe the instructor “note” certain things, their impression of what “good notes” are changes based on the more expert note-taking evidenced (and captured on UP) by instructors. This presupposes that students consider instructor ink captured in class as notes. Interviews are needed to determine if students view instructor ink differently from traditional, freeform boardwork. Others have analyzed ink usage in UP courses [7] and we have recently studied instructor ink in physics [8], but work is needed on the student interpretation and learning possibilities from instructor inking in conjunction with student note-taking.
5. FUTURE WORK
While intrigued by the results of this first study, we plan to further refine our discipline-neutral survey instrument; we plan to ask students to order rank valuations of how class time should be spent and (separately) the learning value of various class activities. These two factors are those we expect to be most directly influenced by use of active learning with UP.

We are less sure about potential of using a survey to assess change in students’ approaches to learning. Perhaps it is not reasonable to expect note-worthy change to un-situated questions about approaches to learning after one term of instruction. After all, we are not specifically spending time teaching students about learning approaches and styles, nor reporting on the results of educational studies in this area. We are teaching physics or computer science – in some cases in students’ first exposures to these subjects. Others [9, 10] report that student views about physics are unlikely to change without explicit attention to those views in class. Perhaps more detailed, interview-based qualitative differences could be found with only one term of instruction. Finally, we recognize that interpretation of the items is key – and we plan to more carefully develop our item set through interviews with students and instructors.

6. ADDITIONAL RESOURCES
http://activecampus2.ucsd.edu/~esimon/UPSurvey/index.php shows the full survey. If you would like to give this survey in your classes, contact Beth Simon.

7. ACKNOWLEDGEMENTS
The authors would like to most graciously thank Shane Walker and Briana Morrison for collecting data for this study, Bill Griswold and the UP team for their comments and support and development of the system. We also thank the IT department at CSUSM, Hewlett Packard, and Microsoft Research for gifts of Tablet PCs and development support for UP.

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Per Student Change in Opposite Direction in Parenthesis

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<td>When studying, I often just go through the motions without seeing where I am going. Toward Disagree</td>
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**Change by use of UP active learning.** We saw only modest increase in student valuation of spending class time to discuss student work – and in the P_A class an equal, sizable move in the opposite direction. We had five items on the survey about the value of spending class time doing X – where X ranged over: listening to the instructor work sample problems, listening to
what other students say, listening to the instructor explain material from the textbook, having students work problems, and listening to the instructor discuss student work. However, students, even in the pre-test, overwhelmingly marked all these as useful expenditures of class time, resulting in little discrimination between items and little possibility of seeing increases in student valuation. For example, in the pre-test of the AL classes, every item on “is it useful to spend class time” had more than 2/3 of the class rank it valuable. In a revised survey currently in deployment, students are explicitly asked to rank order the value of each of these activities in addition to providing valuation.

**Change in active learning in Physics.** In just the physics active learning class, we see two items with positive results that show opposite change in the other three classes. Only in the physics active learning class do more students switch to disagree with the value of memorizing sample problems and fewer report that they often just go through the motions when they are studying. Disappointingly, we see note-worthy movement in the opposite direction in all the other classes. Oddly, 19% more of students in the active learning physics class felt that learning facts and information was “enough” at the end of the term. We are unsure why this is the case, but perhaps despite the problem solving-oriented nature of the class, by the end students are overwhelmed and resort to memorizing strategies.

**Survey Development and Validation**

We identify several issues that need further study regarding validity. The first concerns how students interpreted the items – was our wording too “pedagogical” for students? Did they interpret terms in the same way we intended them? Interviews with students can help develop unambiguous wordings and are currently being conducted.

Second, for some items, the favorable answer (the one consistent with the learning principles we hope students to value) is not well defined – it may depend on context or intent. For example, we ask whether studying a correctly worked problem is more valuable that trying one on your own. From a constructivist perspective, trying to work a problem on your own is a valuable way to build understanding. But we can imagine situations where reviewing a clear, concise, known to be correct solution would be more valuable. For example, when we asked about “studying” it is quite possible students thought of themselves reviewing for an exam – perhaps a time better engaged in solidifying understanding than constructing new understanding. A better wording might have used the term “learning about a new subject”. Even then, perhaps this item still doesn’t determine if students recognize that attempting to construct their own understandings through trial and error is of value.

In two items on the value of “notes” and “notetaking” the affordances of UP itself cloud item interpretation – at least in a post-survey. It may be that students find that the instructor’s ink on slides is a “record of what the instructor said” and therefore, is no longer good material for personal notes – it’s on UP. However, another interpretation has the students interpreting “notes” as not only their own notes, but also what the instructor “noted” in ink. It is possible, then, that as students observe the instructor “note” certain things, their impression of what “good notes” are changes based on the more expert note-taking evidenced (and captured on UP) by instructors. This presupposes that students consider instructor ink captured in class as notes. Interviews are needed to determine if students view instructor ink differently from traditional, freeform boardwork. Others have analyzed ink usage in UP courses [7] and we have recently studied instructor ink in physics [8], but work is needed on the student interpretation and learning possibilities from instructor inking in conjunction with student note-taking.
5. FUTURE WORK

While intrigued by the results of this first study, we plan to further refine our discipline-neutral survey instrument; we plan to ask students to order rank valuations of how class time should be spent and (separately) the learning value of various class activities. These two factors are those we expect to be most directly influenced by use of active learning with UP.

We are less sure about potential of using a survey to assess change in students’ approaches to learning. Perhaps it is not reasonable to expect note-worthy change to un-situated questions about approaches to learning after one term of instruction. After all, we are not specifically spending time teaching students about learning approaches and styles, nor reporting on the results of educational studies in this area. We are teaching physics or computer science – in some cases in students’ first exposures to these subjects. Others [9, 10] report that student views about physics are unlikely to change without explicit attention to those views in class. Perhaps more detailed, interview-based qualitative differences could be found with only one term of instruction. Finally, we recognize that interpretation of the items is key – and we plan to more carefully develop our item set through interviews with students and instructors.

6. ADDITIONAL RESOURCES

http://activecampus2.ucsd.edu/~esimon/UPSurvey/index.php shows the full survey.
If you would like to give this survey in your classes, contact Beth Simon.

7. ACKNOWLEDGEMENTS

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8. REFERENCES