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.

3. SOLUTION EMPLOYED

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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Name	*Institution Type*	*Active Learning Used*	*Validated Responses*
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CS_N	Regional Public	None	17
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On only 12 of 26 items were there note-worthy differences (where we define note-worthy as at least 10% of students switching beliefs) for even one of the classes. Overall, during the course of one term, students do not seem to change many of their beliefs regarding approaches to learning or valuable use of class meetings. In eight of the items we see note-worthy differences either across all classes, or based on the use of UP by the instructor, or based on the use of active learning with UP. In three of these items, we see unique differences for one of the active learning courses.

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

[*] Note the large, but opposite movement also occurring in class Physics_A.

Table 2. Per-Student Notable Change over Term
Per Student Change in Opposite Direction in Parenthesis

Class	Direction of Change	CS_N	P_N	CS_A	P_A
All	*It's more useful for me to study a (correctly) worked example than to try to do a problem by myself.*				
	Toward Agree	29% (0%)	12% (6%)	16% (7%)	19% (19%)
	Reviewing the work of other students outside of class is of little value.				
	Toward Agree	12% (6%)	15% (6%)	14% (4%)	19% (7%)
UP Used by Instructor	*A good set of notes is a record of what the instructor said.*				
	Toward Disagree	6% (0%)	9% (6%)	13% (11%)	15% (4%)
	An important reason to come to class is to have a good set of notes.				
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Active Learning with UP	*It's useful to spend class time listening to the instructor discuss student work.*				
	Toward Agree	6% (6%)	7% (11%)	13% (6%)	10% (10%)
Active Learning in Physics with UP	*It is valuable for me to memorize solutions to sample problems.*				
	Toward Disagree	6% (12%)	5% (14%)	3% (14%)	11% (7%)
	When studying, I often just go through the motions without seeing where I am going.				
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	When learning a subject, it is enough to acquire facts and information.				
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Change by instructor use of UP inking. For those three classes where the instructor used UP to ink on slides and students were allowed to review slides on-line after class, we do see note-worthy (by our 10% rule) changes in student impressions of notetaking. Not only do students no longer find taking a set of notes to be as important a reason for attending class, but they also change in finding that a direct record of what the instructor said is not a "good" set of notes. However, in a Tablet PC environment where instructor ink is available for review, what exactly are "notes"? The possible interpretations cloud analysis and are further discussed in 4.2. We view this result as a positive change consistent with a shift from a transmissionist to a constructivist model of learning.

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.

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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.

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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.

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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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Table 2. Per-Student Notable Change over Term
Per Student Change in Opposite Direction in Parenthesis

Class	Direction of Change	CS_N	P_N	CS_A	P_A
All	*It's more useful for me to study a (correctly) worked example than to try to do a problem by myself.*				
	Toward Agree	29% (0%)	12% (6%)	16% (7%)	19% (19%)
	Reviewing the work of other students outside of class is of little value.				
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Active Learning in Physics with UP	*It is valuable for me to memorize solutions to sample problems.*				
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	When studying, I often just go through the motions without seeing where I am going.				
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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.

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

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