Student Perceptions of Tablet Computers in a Cooperative Learning Environment

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Abstract

Agriculture and biology faculty utilized tablet personal computers in eight different classes as part of developing a cooperative learning environment. After using the tablet personal computers to complete cooperative learning exercises, students in five classes rated how the tablet personal computers impacted their perception of the learning environment. Students in four classes rated how the tablet personal computers affected their ability to interact with other students and their instructor during cooperative learning exercises. A majority of students in the learning environment survey group agreed that using the tablet computers had a favorable impact on their learning environment. Similarly, a majority of students in the interactivity survey group agreed that using the tablet computers had a favorable impact on their ability to interact with each other and their instructor. Based on student assessment results and classroom experience we conclude that the use of tablet personal computers had a positive impact on student perception of their learning environment, thus providing an improved cooperative learning experience. Enhancing wireless access, developing improved cooperative learning exercises, and gaining further experience with the technical aspects of the tablet personal computers will enable us to further enhance the cooperative learning environment in our classes.

Introduction

Today's college instructors are being challenged to develop and implement teaching techniques that promote cooperative learning as a useful alternative to the traditional lecture. Cooperative learning, involving small groups of students working together on a well defined task, has been touted as providing a number of positive benefits to students, including increased generation of new ideas, enhanced self esteem, better communication with other students, and greater motivation to learn (Johnson and Johnson 1989; Slavin 1990, 1995). Hwang et al. (2005) provide evidence that accounting students taught using a cooperative learning model outperformed students taught with a traditional lecture format. Effective cooperative learning requires more than simply having students work together in groups. It involves setting up a well designed, intellectually challenging problem solving activity that includes clear expectations, positive interdependence, group decision making, and individual accountability (Kagan, 1990).

Wireless enabled personal computers, used judiciously, can help instructors provide an effective cooperative learning environment where students are engaged in higher level thinking activities such as problem solving and discussion of complex ideas (Barak et al., 2006; Mackinnon and Vibert, 2002). Effective use of computers to enhance the learning

Table 1. Number and Percent of Learning Environment Survey Group by Class Standing, Age, Major, Prior Tablet Computer Experience, Computer Skill Level, and Attitude Toward Educational Technology (n=107)

Variable	Criteria	n	%
Class Standing	Freshman	21	20
	Sophomore	33	31
	Junior	24	22
	Senior	27	25
	Unclassified	2	2
Age	18-22	85	79
	>22	22	21
Gender	Female	61	57
	Male	46	43
Major	Agriculture	17	16
	Biology	37	34
	Other	53	50
Prior Experience with Tablet Computers	None	65	61
	Low	22	20
	Moderate	17	16
	High	3	3
Self Rating of Computer Skill Level	Low	8	7
	Moderate	69	65
	High	30	28
Do you believe that the appropriate use of computers in the classroom or laboratory can enhance your education?	Yes	96	90
	No	1	1
	Undecided	10	9

Table 2. Number and Percent of Interactivity Survey Group by Class Standing, Age, Major, Prior Tablet Computer Experience, Computer Skill Level, and Attitude Toward Educational Technology (n=90)

Variable	Criteria	n	%
Class Standing	Freshman	15	17
	Sophomore	20	22
	Junior	20	22
	Senior	33	37
	Unclassified	2	2
Age	18-22	62	69
	>22	28	31
Gender	Female	44	49
	Male	46	51
Major	Agriculture	8	9
	Biology	9	10
	Other	73	81
Prior Experience with Tablet Computers	None	50	56
	Low	22	24
	Moderate	14	16
	High	4	4
Self Rating of Computer Skill Level	Low	9	10
	Moderate	44	49
	High	37	41
Do you believe that the appropriate use of computers in the classroom or laboratory can enhance your education?	Yes	79	88
	No	2	2
	Undecided	9	10

environment is related to students' perceptions of their benefits (Fraser, 1998; Walberg, 1984). Student perception of the usefulness of educational technology is also influenced by demographic variables such as age, computer skills, and prior experience with technology (Vankatesh et al., 2003). The objective of this study was to assess student perceptions of the efficacy of tablet personal computers in a cooperative learning environment across a diverse student population encompassing eight agriculture and biology classes.

Methods

Wireless enabled tablet personal computers were provided to undergraduate students in eight courses: Introduction to Animal Science, Introduction to Cellular and Molecular Biology, Introduction to Medicinal Crops, Forage Production and Management, Soils and Soil Fertility, Food Systems of Production, Genetics, and Agricultural Issues in Society. Before using the computers, students in each class completed surveys that asked them to identify themselves by class standing, age, gender, major, prior experience with tablet personal computers, self rating of computer skill level, and attitude toward educational technology (Tables 1 and 2).

Instructors provided opportunities for students to learn how to use the tablet computer and the wireless network before engaging in computer based cooperative learning activities. Each instructor involved in the project modified their traditional lecture format to include several tablet personal computer based cooperative learning activities suitable for their course. Specific cooperative learning activities were of three general types: 1) Internet based student enhanced lectures, 2) Group problem solving activities, and 3) Discussions of ethical issues relevant to the class.

Internet based student enhanced lectures incorporated real time student contributions to the instructors lecture. Students used tablet personal computers to conduct Internet research at selected times during lecture. The instructor's tablet personal computer was connected to a computer projection system and used as an electronic blackboard accessible by students and the instructor. Forage Production and Management students, for example, used the tablet personal computers to research major characteristics of diploid and tetraploid ryegrasses on the Internet. Students subsequently summarized results of their Internet research on the instructor's tablet computer screen so the entire class could view each student contribution and add it to the lecture notes for that class period. To encourage positive interdependency in the activity, students were informed that their contributions were a valued addition to the course content and that their contributions would be included in forthcoming exams.

Group problem solving activities encompassed varied exercises that required students to make management recommendations, to propose resolutions for case studies, or to draw concept maps of fundamental subject matter topics. Introduction to Animal Science students, for example, used the screen-drawing feature of the tablet personal computers to create concept maps of milk components (Figure 1). Concept maps are visual learning tools in the form of diagrams that organize knowledge about a specific topic. Pedagogically, they are used to identify current knowledge, to encourage students to use effective learning patterns, and to determine valid or invalid ideas held by students (Novak and Canas, 2006). The ability to draw on the tablet computer screen and save drawings for grading is an especially useful feature with regard to concept mapping and for providing individual accountability.

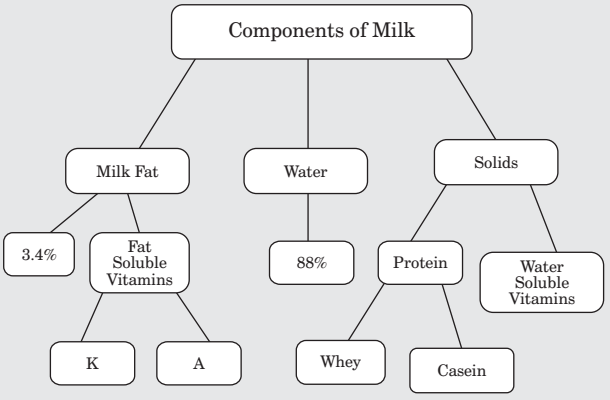

Figure 1. Example of student concept map of milk components.

Electronic mediated discussion of ethical issues utilized shared network drives and email to provide a way for students to post comments on controversial ethical issues relevant to the course. Introduction to Range Management students, for example, viewed a video presentation on the advantages and disadvantages of leasing public land for livestock grazing. Following the video presentation, students used the tablet personal computers to download a series of value laden questions from a shared network drive, e.g. "Is allowing livestock grazing on public rangeland an ethical and effective use of public resources?" Students used tablet personal computers to email responses to the instructor, who posted responses anonymously on a shared network drive. Subsequently, the instructor shared selected student comments anonymously with the class to illustrate differing perspectives of this and other controversial ethical issues related to range management. Near the end of each class, 107 students in five classes were surveyed regarding their perception of the usefulness of the tablet computers in enhancing their learning environment; this group is hereafter referred to as the learning environment survey group or population. Sixty-two students in four classes were surveyed with regard to their perception of how the tablet personal computers affected their ability to interact with other students and their instructor; this group is hereafter referred to as the interactivity survey group or population. Mode and median values were computed for each Likert item to characterize the predominant response to each survey question for both test populations. Test population compositions were analyzed by comparing demographics (class standing, age, gender, major) with responses to computer use questions (prior experience with tablet computers, self rating of computer skill level).

Results and Discussion

Data is reported for two student survey populations. One student survey population was asked to respond to questions about their perception of the classroom-learning environment, and is hereafter referred to as the learning environment survey group or population. The second student survey population was asked to respond to questions about their ability to interact with each other and their instructor, and is hereafter referred to as the interactivity survey group or population. Both student survey populations were diverse with regard to class standing, age, major, gender, prior experience with tablet computers, and self-rating of computer skill level (Tables 1 and 2), distinguishing our study from earlier studies that involved more selective student populations (Barak et al., 2006). Sophomore students and females were a slight majority of both survey populations. There were approximately equal numbers of agriculture/biology majors and non- agriculture/biology majors. Non-traditional students, who have a generally observed tendency to describe themselves as less computer savvy than their younger peers, made up 21% of the learning environment survey and 31% of the interactivity survey group. Eighty-one percent of the learning environment survey group and 80% of the interactivity survey group had little to no prior experience with tablet personal computers. Students in both survey populations overwhelmingly indicated that the "appropriate use of computers" (Tables 1 and 2) could enhance their education. The interpretation of "appropriate use" will vary among students, just as it does among teachers; nevertheless we believe that the majority agreement with the statement indicates both survey populations were favorably inclined toward using of computers in their college classes. Despite this apparent favorable inclination toward using computers in the classroom, only 28% and 41% of the learning environment survey group and interactivity survey group, respectively, rated themselves as highly skilled computer users.

In the learning environment survey group, freshman indicated the greatest confidence in their computer skills (Table 5), lending credence to the supposition that they may be more comfortable and accepting of using computers in cooperative learning exercises. Similarly, 30% of traditional students (age 18-22) rated their computer skill level as high, versus 18% of non-traditional (age >22) students. In addition, 78% of senior students indicated no prior experience with tablet computers, versus 52% of freshman. Collectively, these observations suggest that future college students may come more prepared and more accepting of computer use in cooperative learning exercises. Demographic analysis of the interactivity survey group reveals an older student population with a higher proportion of upperclassman (Table 6). In contrast to the learning environment survey group, 48% of senior students rated their computer skills as high, versus 20% of freshman students. As a whole, demographic data collected in the study validated that we met one of the key objectives of this study, i.e. to sample a diverse college student population.

A majority of students in the learning environment survey group, as indicated by percent agreement, median, and mode, signified a positive percep-

tion of the effectiveness of the tablet personal computers in improving their learning environment (Table 3). Seventy-five percent of surveyed students agreed or strongly agreed that using the tablet computers enhanced their ability to understand key concepts. Seventy-eight percent of surveyed students agreed or strongly agreed that the tablet computers added interest to the class, suggesting that the cooperative learning opportunities provided by the tablet personal computers generated additional student motivation, a key element of effective learning (Lynch, 2008). Sixty-one percent of surveyed students agreed or strongly agreed that the tablet personal computer helped them develop well-formulated responses to discussion questions, supporting the usefulness of the tablet personal computers in facilitating creditable student accountability, a key parameter of successful cooperative learning. Similarly, 61% of students surveyed agreed or strongly agreed that the tablet personal computers had a positive influence on their ability to learn. Median and mode values for all questions, an indication of the most common survey population response, confirmed that the majority response was agreement with positive statements about the use of the tablet personal computers (Table 3). Survey results from the learning environment survey group reveal a consistent pattern of favorable student perceptions that validate the value of the tablet personal computer based exercises in fostering productive cooperative learning.

Table 3. Student Response to Statements Regarding the Effect of the Tablet Personal Computer on their Perception of the Learning Environment (n=107)

	Median	Mode	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
			n	%	n	%	n	%	n	%	n	%
Integrating the tablet personal computer into lecture enhanced my ability to understand key concepts.	4	4	0	0	6	5	21	20	67	63	13	12
Using the tablet personal computer added interest to the class.	4	4	0	0	2	2	21	20	55	51	29	27
Using the tablet personal computer in a group helped the group develop well formulated responses to discussion questions	4	4	0	0	4	4	37	35	56	52	10	9
Using the tablet personal computer had a positive influence on my ability to learn	4	4	0	0	10	9	32	30	51	48	14	13

Median, mode calculated as: Strongly Disagree =1.0, Disagree=2.0, No Opinion=3.0, Agree=4.0, Strongly Agree=5.0

A majority of students in the interactivity survey group, as indicated by percent agreement, median, and mode, signified a positive perception of the effectiveness of the tablet personal computers in improving their ability to interact with each other and with their instructor (Table 4). Sixty-six percent of the survey population agreed or strongly agreed that using the tablet computers helped them interact more effectively with their fellow students. Similarly, 69% of the survey population agreed or strongly agreed that using the tablet computers helped them interact more effectively with their instructor. Median and mode values for all questions confirmed that the majority response was agreement with positive statements about the effectiveness of the tablet personal computers in improving their ability to interact with each other and their instructor (Table 4). Effective interaction among students and instructors has been identified as one of the five critical factors needed for successful cooperative learning (Nagel, 2008). Interactivity survey results provide convincing support for the value of the tablet computers in enhancing cooperative learning.

Although a majority of students indicated a positive perception of tablet computer effectiveness, a noteworthy portion of the learning environment survey populations indicated "no-opinion" in their perception of the effectiveness of the tablet personal computers in enhancing the learning environment. Thirty percent of surveyed students, for example, had no opinion with regard to the statement: "Using the tablet personal computer had a positive influence on my ability to learn." This response may reflect the inexperience of both students and instructors with the technology. Only one instructor involved in the project had substantial prior experience with the tablet personal computer, and 80% or more of the students had no prior tablet personal computer experience. Technical difficulties such as the inability to log on to the wireless network were a regular occurrence in the early use of the tablet computers, and there was notable frustration among both faculty and students in the initial stages of the project. Frustration notably declined as students and instructors became more proficient in the use of the tablet computers. It is plausible to postulate that some of the no-opinion response is due to the frustration of using limited class time to deal with technical difficulties instead of completing the cooperative learning exercises in an efficient fashion. The considerably sized no-opinion group offers an important cautionary reminder to instructors who integrate computer technology into the classroom, i.e. significant time and effort will be required to develop well organized and executed exercises.

Table 4. Student Response to Statements Regarding the Effect of the Tablet Personal Computer on their Ability to Interact with their Fellow Students and their Instructor (n=62)

	Median	Mode	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
			n	%	n	%	n	%	n	%	n	%
Using the tablet personal computer to participate in electronic discussions helped me to articulate my thoughts about ethical issues more effectively than in oral discussions.	4	4	0	0	5	8	19	30	27	44	11	18
Using the tablet personal computer helped me interact more effectively with other students	4	4	0	0	7	11	13	21	32	52	10	16
Using the tablet personal computer helped me interact more effectively with my instructor	4	4	0	0	9	15	10	16	34	54	9	15
Using the tablet PC to make contributions to the class discussion was more comfortable for me than contributing orally in front of the class.	4	4	1	2	7	11	13	21	26	42	15	24

Median, mode calculated as: Strongly Disagree =1.0, Disagree=2.0, No Opinion=3.0, Agree=4.0, Strongly Agree=5.0

Table 5. Demographic Analysis of Learning Environment Survey Group

	Prior Experience with Tablet Computers				Self Rating of Computer Skill Level		
	None	Low	Moderate	High	Low	Moderate	High
----------% (n) Selected Group Population----------							
Class Standing							
Freshman 20 (21)	52 (11)	29 (6)	19 (4)	0 (0)	1 (1)	54 (11)	45 (9)
Sophomore 31 (33)	61 (20)	12 (4)	18 (6)	9 (3)	9 (3)	73 (24)	18 (6)
Junior 23 (24)	46 (11)	38 (9)	16 (4)	0 (0)	1 (1)	68 (16)	31 (7)
Senior 26 (27)	78 (21)	11 (3)	11 (3)	0 (0)	7 (2)	67 (18)	26 (7)
Age							
18-22 79 (85)	59 (50)	24 (20)	15 (13)	2 (2)	6 (5)	64 (54)	30 (26)
>22 21 (22)	68 (15)	9 (2)	18 (4)	5 (1)	14 (3)	68 (15)	18 (4)
Gender							
Male 43 (46)	62 (28)	26 (12)	11 (5)	1 (1)	11 (5)	61 (28)	28 (13)
Female 57 (61)	61 (37)	16 (10)	20 (12)	3 (2)	5 (3)	67 (41)	28 (17)
Major							
Agriculture 16 (17)	36 (6)	29 (5)	29 (5)	6 (1)	6 (1)	65 (11)	29 (5)
Biology 36 (38)	71 (27)	13 (5)	16 (6)	0 (0)	8 (3)	71 (27)	21 (8)
Other 48 (50)	62 (31)	22 (11)	12 (6)	4 (2)	6 (3)	62 (31)	32 (16)

Numerous studies indicate that well planned and executed computer based learning activities are essential to effective student learning (Bassoppo-Moyo, 2008). Our results suggest that a student population that was highly favorable to computer use in the classroom (Tables 1 and 2) in general was not always as favorable in their perception of the usefulness of the tablet computers.

Ideally, college instructors desire that all students contribute to class discussions, while appreciating the reality that this rarely occurs, especially in larger groups of students. Students that feel uncomfortable contributing in open class discussions are one reason for the lack of universal participation. In the Introduction to Range Management class, we conducted the cooperative learning activity to determine if the use of the tablet personal computers to post contributions anonymously

Table 6. Demographic Analysis of Interactivity Survey Group

	Prior Experience with Tablet Computers				Self Rating of Computer Skill Level		
	None	Low	Moderate	High	Low	Moderate	High
----------% (n) Selected Group Population----------							
Class Standing							
Freshman 17 (15)	60 (9)	33 (5)	7 (1)	0 (0)	13 (2)	67 (10)	20 (3)
Sophomore 23 (20)	60 (12)	15 (3)	20 (4)	5 (1)	15 (3)	45 (9)	40 (8)
Junior 23 (20)	50 (10)	25 (5)	20 (4)	5 (1)	15 (3)	45 (9)	40 (8)
Senior 37 (33)	55 (18)	27 (9)	15 (5)	3 (1)	4 (1)	48 (16)	48 (16)
Age							
18-22 69 (62)	56 (35)	23 (14)	16 (10)	5 (3)	10 (6)	48 (30)	42 (26)
>22 31 (28)	54 (15)	28 (8)	14 (4)	4 (1)	11 (3)	50 (14)	39 (11)
Gender							
Male 51 (46)	50 (23)	26 (12)	17 (8)	7 (3)	13 (6)	54 (25)	33 (15)
Female 49 (44)	61 (27)	23 (10)	14 (6)	2 (1)	7 (3)	43 (19)	50 (22)
Major							
Agriculture 7 (6)	50 (3)	33 (2)	17 (1)	0 (0)	0 (0)	67 (4)	33 (2)
Biology 10 (9)	33 (3)	23 (2)	33 (3)	11 (1)	0 (0)	56 (5)	44 (4)
Other 83 (75)	59 (44)	24 (18)	13 (10)	4 (3)	12 (9)	47 (35)	41 (31)

could improve class participation with regard to a controversial topic. Anecdotally, the course instructor noted that the quality and extent of class participation was the highest he had observed in over ten years of classes. In accordance with this observation, 66% surveyed agreed or strongly agreed that the tablet computer provided them with a more comfortable way to contribute to class discussions as compared to an oral contribution. A small, but notable portion of the survey population, ranging from 21% to 30%, expressed no opinion as to the usefulness of the tablet computers in their classroom interactivity or their ability to articulate responses to ethical issues. A similar trend was observed in the learning environment survey group. As indicated earlier, we attribute some of this to the lack of experience with the technology by students and instructors. Overall, the survey results, in terms of student agreement, median values, and mode values, provide convincing evidence that the tablet personal computer can play a helpful role in cooperative learning by encouraging and enabling more students to contribute to class discussions.

Summary

A growing number of college instructors are investing considerable time and effort into developing computer based cooperative learning components into their courses. In a related trend, it is commonly observed by instructors that more college students are coming to campus with computers and with the expectation that their computer skills will become a significant part of their educational experience. Notebook computer use by college students increased from 52.8% in 2005 to 75.8% in 2007 (Salaway and Caruso, 2007). Instructors are attempting to meet this expectation by developing and implementing computer-based cooperative learning exercises that provide tangible benefits to the learning process. The results of our study demonstrate that the judicious use of tablet personal computers can enhance cooperative learning in a diverse student population. As students gradually become part of the cooperative group process of sharing knowledge and experiences, they may be more likely to make connections that will help them excel in their studies, gain confidence in their ability to contribute to class discussions, and persevere in their studies through graduation.

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