KNOWLEDGE SHARING SYSTEMS: ADVANTAGES OF PUBLIC ANONYMITY AND PRIVATE ACCOUNTABILITY

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This paper explores the benefits of the design elements of public anonymity and private accountability in classroom Knowledge Sharing Systems (KSS). The major findings of this study indicate that classroom KSS have the potential to allow for greater equity of input, reduce academic anxiety, increase teachers knowledge of student understanding and improve student participation. .

INTRODUCTION

This paper explores the benefits of the design elements of public anonymity and private accountability in classroom Knowledge Sharing Systems (KSS). These systems allow participants in a class to input information into a computer database and makes that information available to others. For this paper, classroom KSS are defined as computer mediated systems that allow for free response student input, perform some sort of input aggregation, and make the input data available back to the classroom in a meaningful format. Allowing for free response student input specifically refers to allowing the students the ability to enter many different types of data (text, functions, graphics). Public anonymity refers to the ability of the student to submit data to be viewed by the entire class in a way that their identity is not revealed to fellow students. The teachers ability to access who made each submission is private accountability. This paper will focus on a classroom KSS which allows students to do synchronous data input. The author draws on four years of classroom observations using a prototype classroom KSS.

Until recently, in Education research, the predominance of research with classroom KSS which allow for anonymous input has been done using asynchronous data input (Cohen & Scardamalia, 1998; Hoadley & Linn, 2000; Hsi & Hoadley, 1997; Scardamalia & Bereiter, 1992; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989). The exception to this would be work done using the ClassTalk system designed by Louis Abrahamson (Abrahamson, 1998; Mestre, Gerace, Dufresne, & Leonard, 1996). ClassTalk allowed students to do parallel data entry and aggregated the responses in a group display. In the field of Communication research, systems allowing for synchronous data input have been the predominant focus (Connolly, Jessup, & Valacich, 1990; Gallupe & Cooper, 1993; Jessup, Connolly, & Galegher, 1990; Scott, 1999; Valacich & Dennis, 1992). The systems used in Communication research grew out of research on brainstorming in group settings and will be described in greater detail later in the paper.

The major findings of this study indicate that classroom Knowledge Sharing systems have the potential to allow for greater equity of input, reduce academic anxiety, increase teachers knowledge of student understanding and improve student participation.

THE TECHNOLOGY

The technologies being in the classrooms described in this paper are two different versions of a prototype network of handheld devices in development by Texas Instruments. Both prototypes were completed to a "proof of concept" level for experimentation. The goal of placing the early prototypes in a limited number of classrooms was to gain insight into what uses teachers would find for a network of handheld devices. The first prototype version of the classroom network was a wired network comprised of a series of hubs linked together from group-of-desks to group-of-desks. Each of the hubs allowed up to four handheld devices to be connected. The devices used were the TI-83, a graphing handheld. The TI-83 is a stateless device that can be programmed but has no flash memory. The daisy-chained series of hubs were connected to a computer at the front of the room. The teacher accessed a computer side interface to send and get data from the devices.

The second prototype version of the system was architecturally different from the first. This system was wireless and designed with a server-side database. The server was located in Dallas, Texas and the schools using the system gained access via the Internet. This system was composed of nine wireless hubs, an access point, and a concentrator gateway. Each hub allowed up to four handheld devices to connect to it. The devices used were the TI-83 Plus, a graphing handheld, which unlike the TI-83, has Flash ROM. The wireless hubs communicated with the concentrator gateway via an access point. Activities were created through a combination of server side XML scripts and device programs. Unlike the previous system where the send, get, and aggregate commands originated on the computer interface, data movement protocols for the second prototype are built into a device side application. In the second prototype, the classroom computer is used to cue activities and view individual student data. The devices allow for text and numeric input and are fully programmable through a Basic-like language. Both systems use an overhead ViewScreen™ panel that displays the teacher devices' screen.

OVERVIEW OF COMMUNICATION RESEARCH

The research on knowledge sharing systems in the field of Communications grew out of research done to find the most effective group brainstorming environment. Brainstorming groups have been used for many years in businesses. Ideally, a small group will meet, call out ideas, get inspired by each others ideas, and produce a wealth of beneficial information for the company. Key things which hinder this are, Production Blocking - waiting your turn, someone saying what you were going to say, deciding your input was "stupid" and not saying anything and Evaluation Apprehension - peoples anxiety over what others may think of what they are saying (Connolly et al., 1990; Jessup et al., 1990; Valacich & Dennis, 1992). Starting with early group brainstorming research, it was thought that groups interacting verbally would produce a greater quantity of higher quality ideas than individuals working in isolation (Osborn, 1957). It has been found that the dynamics of waiting your turn to speak and politics inherent in group situations actually make verbal groups less productive for idea generation (Connolly et al., 1990). Research has shown that face-to-face verbal brainstorming groups are not as effective as nominal groups (groups where individual participants write ideas on paper and then submit their papers at the end of the designated time). Face to face groups fall behind in

both number of ideas submitted and the quality of those ideas(Valacich & Dennis, 1992). Growing from Osborn's early speculation that seeing other peoples ideas should help groups create more and better ideas. Electronic Brainstorming Systems (EBS) and a Computer Decision Support Systems (CDSS) were created(Gallupe & Cooper, 1993; Jessup et al., 1990). Both allow for all individuals in the meeting to input ideas simultaneously, anonymously and see what others have submitted. Research using Electronic Brainstorming Systems has found that these systems become more and more effective the larger the group size. Studies done with groups up to 18 showed that larger groups were the most productive creating a greater quantity of higher quality ideas (Gallupe & Cooper, 1993). Previously, verbal groups were shown to peak for effectiveness around 4-7 members with additional members actually decreasing productivity. With knowledge sharing systems, larger and larger groups became more effective (Valacich, Dennis, & Connolly, 1994). The parallel to classroom situations is interesting. With classes typically having twenty-five students or more, a classroom KSS could add tremendously to the effectiveness of the communication.

PUBLIC ANONYMITY

Greater Equity of Input

In the networked classroom, students can submit answers to be considered by the class without their identity being associated with that information. Teachers can identify whom the individual information comes from on the computer monitor, but in the group display space, the responses are anonymous.

Anonymity facilitates the ability to explore answers in a non-threatening way. It gives the ability to ask questions like, "What do you think the person who sent in this point was thinking?" or "Who can defend this answer." without tying the identity of the student who sent in the response to the question. This gave the possibility for non-threatening discussions of the ideas. Students can discuss the thought that went into an answer independent of assigning that answer to a specific person. Freed from *who* sent in the answer, they are able to explore *what* the answer might mean.

> Teacher: Where with Navigator, I can see the various equations and the differences in the equations and then that promotes discussion. Well what's different? - well obviously the numbers are different but what do these numbers represent, why is it different, and why would somebody have that. It just promotes a lot of discussion and everybody's free to discuss it because kids can be criticizing an equation that they themselves wrote that nobody would know. And they do sometimes, sometimes they'll say, and that's the surprising thing, is after a relatively short time the kids are very open about saying, "Oh that was me, and the reason I did that is...". Um and, it's interesting because it gives, even if, if I'm the one who got the right equation, it's interesting listening to somebody who got a wrong equation because that sorta solidifies, perhaps solidifies my correct concept of why my, why I choose what I choose. But, sometimes kids get somewhat lucky when they're making choices and as they're listening to somebody else, and this has happened, they're listening to somebody else's explanation and they'll go, "Oh no, I didn't do it that way." And so they got the right answer for the wrong reason. Um, and that's, that's interesting because they're, they're really truly understanding what's going on by listening to other people. And, it also helps them see that somebody

else may have gotten a totally wrong answer, but in trying to analyze what was wrong about it they were just off on a totally, on a different track. Obviously a wrong track, but its, its not that the person was, was stupid in what they did, they just misinterpreted something. So I think it helps a lot, by having discussions.

Research done using other computer mediated knowledge sharing systems, on the effects of anonymous input, has found that allowing students to submit new ideas or respond to previously submitted ideas, anonymously creates a more equitable environment where boys and girls participate equally (Hoadley & Linn, 2000; Hsi & Hoadley, 1997; Scardamalia & Bereiter, 1992). These three research studies were done using knowledge sharing systems which allowed students to submit data asynchronously. Findings from these studies show that allowing the option of anonymous input creates a more equitable environment for participation (Hoadley & Linn, 2000; Hsi & Hoadley, 1997; Scardamalia & Bereiter, 1992).

Reduces Academic Anxiety

Students identify with their response, icon, data, etc., that shows up in the group display. They want to see their data up front. The anonymity allows them to choose if they identify their representation to others, but all are very conscious of seeing themselves in the group display. Additionally, seeing their response in the group display has made students more accountable to the class.

Where's my point? Who am I? That's my answer! are all common exclamations to hear when running a networked activity with students.

With time, this representation of self in the group space can give the students a sense of how they are doing relative to the class as a whole. As one example, in the class in Islandtown, the students come into class every day and enter their responses to a subset of the homework problems. As a class they then look at the responses and discuss the problems that were the most difficult. This daily activity of seeing how many people got which problems correct, helped the students to feel more comfortable with the idea that some days you understand and some days you don't. They articulate how this let them feel more comfortable in class and more confident to ask the teacher for help.

Interviewer: Why do you think the system is important in the classroom?

Student 12: It just helps everybody open up, and everybody interact, and it really just opens up the classroom because then you know what you need to study, you know where you stand and you know how everybody else is standing and it makes you feel comfortable because you're kind of involved in everybody else and how they're doing in the class. So it makes everybody kind of closer in this class. Cause I know in other classes, I have no idea how anybody's doing. Sometimes I feel like I'm the only kid who's getting bad grades. And I'm the only kid slipping behind, but here I know what's going on and it just makes it more comfortable definitely to come here everyday.

Interviewer: Does that, in the other classes where you don't know how other people are doing (Student 12: Right), you don't know if you're the only one (Student 12: Right), does that raise your anxiety level any...?

Student 12: Oh Definitely! Yeah it's scary, because I think I'm the only one...I'm looking at my test, I think I'm the only one who got a 60 or whatever. And the couple of kids around me I'll know what they got but then I have no idea how anyone else is doing, because it's all privately done. Not that I need to know their test grades, but I'd like to know, how I stand. Am I the only one who needs help? And then you feel embarrassed to be the one raising your hand all the time, be the one staying after class because you think you're the only one. So, here, it's a lot more comfortable. You're not embarrassed in front of the other kids.

Interviewer: So it's really helpful to know when you're the only one, but it's also really important to know when you're not the only one (Student 12: Right) because it kind of gives you the courage to (Student 12: Exactly) ask questions more often?

Student 12: Yeah and then you feel like you're not a failure in the class it's not a big deal if you can't understand it, you just work harder because other kids are having the same problem...

In a visit subsequent to the one where the quotes in this paper where gathered, the teacher related to me some of her observations. She was surprised to find that the community effects of the system were not persistent. When the system was not working, she noticed that the students went back to not asking questions. In one of her classes that day we staged a mini experiment. The students reviewed the first half of their homework without using the network and the second half using it. Without the histogram display of responses, the class discussion was poorer. At the end of class we held a question and answer session with the class focusing on why the students thought they participated differently when the group display was available than when it wasn't. Here is a synopsis of their comments.

1. Without seeing the histogram of everyone's responses, if you get a question wrong, you are afraid to ask why.
2. Without the system, whoever speaks up first, wins the argument. If the person who speaks first seems to be agreed with by the majority of the class, others get insecure and won't talk about other possible solutions.
3. With the histogram, if you see that at least one other person in the class selected what you did, it gives the confidence to defend the answer. Without the histogram, you are afraid that you are the only one.
4. With the histogram, the answer is out there to defend, it doesn't even have to be yours.

Without the aggregated view, the students felt that they did not have the information they needed to fully discuss the homework.

There was a second school in the pilot site community where data was also gathered. A feature of the KSS prototype was that it allowed teachers to create their own activities. The teachers at the second school saw no reason to create their programs with an aggregate data display. It just did not occur to them that the students would gain anything from seeing the aggregate display. The activities that they created had the student results sent to the teacher computer and rarely sent an aggregate of the class data to the display. In interviews, the benefits of anonymity as seen in the "Assessment" and "You can't fake it" transcripts were universal across both sites. But one of the key

features of the system, the ability of students to identify with data in the display space was missing. Absent from the student comments from this site was the powerful sense of community and meta analysis of understanding seen at the Islandtown site.

PRIVATE ACCOUNTABLITY

Increase Teacher Knowledge of Student Understanding

Assessments are only meaningful if the results can be interpreted in a manner and in a timeframe useful to the teacher. A KSS that allows for anonymous, parallel response to questions by all students and gives the teacher tools to analyze those responses, allows for many more meaningful assessment opportunities.

The teacher in Islandtown, taught Advanced Placement Calculus. Her reality was that the entire course was to get the students prepared to take the AP Calculus test which is mostly multiple choice. For this reason, all of the homework that she assigned came from AP practice tests and was in Multiple Choice format. She used the classroom KSS daily to facilitate discussions during review of the students homework.

> Teacher: It's great to know, where the kids are, actually it's not always great because sometimes it's pretty depressing to see where the kids are. There was something I did this year in one of my classes and I asked if there were any - I thought I had done a fine job - I asked if there were any questions, nobody had any questions and I just had an inkling, And I said okay well log on and lets check. And I believe two kids got it right so obviously they didn't have a clue what they were doing and I went back and retaught.
>
> (Later in interview)
>
> Teacher: I feel really strongly that this product is an invaluable tool for educators. As teachers, I keep going back to assessing, which is not the only thing that TI-Navigator does and I'll address that in a minute, but as teachers we need to assess our students and ourselves and it's instantaneous and its real and its so important to know where the kids are at. And what you think you taught, and what you feel you explained really well, is not always what they received and to wait for a test two weeks from now, meanwhile you've built on that concept, and if a child has had difficulty with the concept in the beginning and you're building on it, everything is going to fall apart. And with TI-Navigator you cannot only check that concept, you can go back and check very basic concepts. There are all sorts of almost game-like activities that you can do with the kids where you can get a real good sense for what's going on with out the intimidation of a test and the pressure of a test, and that's wonderful.

Being able to gather all student responses gives the teacher options for how to proceed in class. The teacher could ask questions after a lesson is completed to find out if the topic is understood or must be re-taught. Student responses to a pre-test could be gathered before a new unit is taught to gauge students' prior knowledge. Foundational concepts could be reviewed or introductory lessons could be skipped depending on what the result of the pre-test indicate. A teacher could ask content knowledge questions and then use that information to form cooperative groups with greater confidence that student ability needs and strengths were matched (Bellman, 2002). The ability to gather responses on all

questions from all students is important because of the knowledge it gives the teacher, and what the teacher is then able to do with that knowledge.

Improve Student Participation

The ability for all students to answer all questions is powerful for what it allows the teacher to understand. It is equally powerful for what it allows for the student. Not raising your hand or avoiding eye contact no longer lets a student off the hook for participation. The network enables all students to be more engaged in the classroom.

Student 11: It kind of forces you to do your homework because if the number of responses you know, don't match the number of people in the class, you know (Student 10: And she can check), and she checks, (Student 9: Yeah). So it kind of makes you keep on top of yourself also,

Student 9: Yeah

Interviewer: Is forcing you to do your homework a good thing?

Student 10: Probably

Student 9: Yeah, definitely.

Interviewer: Is it?

Student 11: That's one of the classes I'm the most prepared in. I think that TI-Navigator does help, because, it kind of forces you to do it. Things are...

Student 9: She can tell if...inaudible...)

Student 11: She can tell if you using this if you're not doing it and if your not, you know...

Student 10: You can't fake it.

Student 11: You can't fake it

With a classroom KSS the teacher can see who has and has not submitted a response. Because the responses are anonymous to the rest of the class, which mitigates student embarrassment, it is okay to "force" all students to answer.

CONCLUSION

For a long time, the benefits of classroom knowledge sharing systems have been reserved for classes working in conjunction with university based research projects. As these systems are now becoming commercially available, we will soon be able to see their benefits across a much greater population. There will be a need for professional development to help teachers integrate the functionalities of these systems into their classes. Simple things like showing the aggregate results of student responses back to the class are easily overlooked as not being important if their impact in not explained. With the insight given to all students about their understanding and how others are doing, classroom KSS have a powerful impact on how students experience even simple activities like reviewing homework.

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