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## **Learning through Question and Answer Interactions on the Web.**

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### **ABSTRACT**

The paper discusses the use of a Question and Answer section of a Discussion Board on a computer-mediated web conferencing tool, and the way in which this facility fits with ideas of social learning. Theoretical perspectives of social learning with computers are explored. A study of the use of a Question and Answer facility in a first year mathematics education subject for primary student teachers is discussed. Examples will be given of how learning was developed through questions and answers in this subject and insights will be shared regarding the various uses of this facility by the students. Issues related to participation, peer misconceptions and teacher intervention are raised and discussed.

### **INTRODUCTION**

Over the last two decades, education has been undergoing major paradigm shifts. These shifts include changes in theories of learning from transmission to constructivism and moves from teacher-centred to student-centred control of learning situations (Barker, 1999). As in other areas of Higher Education, mathematics educators in teacher education have the challenge of conveying this different vision of learning to their students. Students' initial expectations are that the lecturer will act as an "expert" transmitting valuable information and telling the students what they need to know to perform well in their chosen occupation (Schuck, 1996). In our subjects we employ computer-mediated conferencing as one of the means of challenging student beliefs about learning, teaching and mathematics education (Schuck & Foley, 1999). This paper focuses on the pedagogical value of using a Question and Answer facility in computer-mediated conferencing. It is my purpose in this paper to illustrate how the use of Question and Answer interactions on the Web fit well with views of learning as a socio-cultural activity. The paper also contributes to the debate about peer misconceptions and about student expectations about learning.

It is becoming increasingly common for teacher educators to base their teaching philosophies on principles of social learning (Putnam & Borko, 2000). Social learning situations involve learners in actively constructing meaning, not in isolation, but in collaboration with others. Salomon and Perkins (1998) suggest that learning usually entails some social mediation. They elaborate on two forms of social mediation of learning: (1) active social mediation of individual learning, whereby a person or a team assist the individual's learning and (2) social mediation as participatory knowledge construction, whereby learning is seen as "a matter of participation in a social process of knowledge construction" p 4. This paper focuses on the second form of learning and discusses how a question and answer forum can contribute to shared knowledge construction.

A dilemma exists for teachers who wish to encourage students to share collaboratively in knowledge construction. On the one hand, they wish to act to enable learners to develop new insights and develop their abilities; on the other, they act as 'gatekeepers' in leading students to construe the objects of their learning in an appropriate manner. Consequently, the decision by the teacher to interpose with an opinion or suggested course of action can be a delicate one. Both teacher and students may be concerned that lack of intervention by the teacher will lead to the propagation of misconceptions. An added difficulty can be the student's view of the teacher as 'expert' where the expectation is that the teacher will simply 'tell' the student what is required (Baker & Dillon, 1999). However, the lack of teacher intervention may also contribute to the creation of learner autonomy, and to orienting the learner towards the community rather than the teacher alone. This occurrence in the use of the electronic question and answer section of the mathematics education discussion board will be shared in this paper.

### **The use of computer-mediated learning to promote participatory knowledge construction**

The research literature on computer-mediated learning indicates that computer-mediated conferencing tools are especially well-suited for providing social arrangements that enable collaborative construction of knowledge (Blanton, Moorman, and Trathen, 1998). A number of researchers have reported on the advantages of Web-mediated conferencing where students have collaborated in learning tasks (for example, Collison, Erlbaum, Haavind and Tinker, 2000; Sherman, 1995).

Windschitl (1998, p.30) raises the question of whether 'communities of learners evolve' when students collaborate in learning projects on the Web. Shulman, quoted in Sherin, Mendez and Louis (1997), cites four pedagogical principles which help to foster a community of learners: activity where the learner actively participates in the discussion; reflection where the learner reflects on and analyses his or her own thinking; collaboration in which the learners support each other's learning; and community, where a class is seen not as just a collection of individuals, but as a learning community. Web-mediated conferencing would appear to be well suited to the utilisation of these principles.

## **How question and answer forums fit in a view of social learning.**

This paper discusses the aspect of a mathematics education subject in a teacher education program, in which students were encouraged to use a Question and Answer discussion forum created in a web-based conferencing tool. For me, the introduction of a Q&A section fitted well with my theoretical framework for teaching, one in which socio-cultural factors are seen as important in learning. I believe in the importance of communities of learners and in opportunities to create rich questions or to encourage students to pose their own questions for investigation. I also value opportunities for debate amongst the students in which the teachers are not constructed as the sole “experts” transmitting facts. The Q&A section appeared to serve this context well. In what follows I discuss this use of the Q&A facility and also raise issues about participation and teacher roles.

### **THE STUDY**

First year primary teacher education students at an Australian university are enrolled in a mathematics education subject in their second semester. The subject is primarily offered in face-to-face mode on campus. However, one component of the subject involves the use of a computer mediated discussion tool. A Question and Answer forum has been placed on the discussion board and students are encouraged to post questions about the use of the technology or about the content of the subject. One component of the subject is the study of measurement, which has the aims of developing student teachers’ understanding of the underlying concepts as well as teaching student teachers how to teach topics in measurement in the primary school. Students are encouraged to develop their understanding of the measurement concepts, and how to teach them, by posting questions on the discussion board. Students are also invited to respond to any of the questions or statements made in this section. In this way students act as advisers for each other, or share ideas on any of the issues raised in class. Students generally have the necessary technical skills as they are required to participate in other forums.

The reason for having a question and answer (Q&A) forum as part of the Discussion Board (there are a number of other forums operating simultaneously, on different aspects of the subject) was that it appeared that the Q&A activity could model quite well the shifts in practice advocated by the reform movement in school mathematics. These reforms encourage students to work as mathematical communities and to use logic and mathematical evidence as verification, rather than accepting the teacher as sole authority (NCTM, 2000).

My intention in the subject is to provide opportunities for students to participate in a learning environment which reflects these reform ideas. I am also eager for students to develop models of learning that do not limit their perceptions about who may be the “authority” on questions of mathematics or mathematics learning.

Although there is no direct assessment grade given for interaction in the Q&A section, students are given a participation mark for their work in the whole subject, and this participation can include interaction in the Question and Answer section if the student chooses. However, there are other ways that students can choose to be graded for participation, including participation in face-to-face discussions.

In the study, I considered the experiences of the students over two offerings of the subject, in subsequent years. I evaluated the Questions and Answers section by monitoring the content that appeared in this section of the Discussion Board. We also had a mid-semester evaluation in which students were asked to write what they liked and disliked in the subject and what they thought about the question and answer section. These evaluations were anonymous. Finally students’ written reflections on their learning during the semester were also examined for relevant issues. For this paper, I will discuss some of the issues that students raised and also give some examples of powerful learning that took place through the Q&A facility.

### **Findings from the Question and Answer section of the discussion**

About 40% of the 150 students used the Q&A forum. Of those who did, 66% found it interesting and worthwhile. Those who were critical of its use expressed a number of views: some felt that they had nothing to say and were being coerced into using the discussion as it would give the lecturers a good impression of them, others found difficulty in accessing the site. Some students were concerned that their peers’ answers to questions might be incorrect and they did not feel able to assess whether this was the case.

One characteristic of the interactions, which was paralleled in the face-to-face interactions, was that usually a core of students would participate in the online discussion. For these students, there were obvious benefits demonstrated (see examples below). However, many other students did not visit the discussion site at any point, either because they did not have ready access to computers from home (although they were able to use computers at the university at any time) or because they did not view such interactions as meeting their needs. This point matches the findings of Selwyn (2000) who had similar experiences in a network of special education teachers. It supports the view that electronic learning environments do not suit all learners (Hartley & Bendixen, 2001) and the opportunity to learn in different ways, using different tools and approaches should be offered to all learners.

For those who did participate in the Q&A section, their interactions appeared to be useful and resulted in some powerful learning for some of the students. Examples of how the facility was used are given below. It is interactions like those in the first example, that appear to demonstrate the strength of the tool for developing collaborative learning and for promoting deeper thinking. A discussion of this example follows.

A question had been posed in class as to how the area of an irregular shape could be measured. A student (George) responded by saying that the border of the shape could be measured with string and then that length of string could form a circle and the area of the circle could be calculated. We did not discuss the question further but asked students to think about the solution. We had hoped one of them would pose it in the Q&A section but after waiting a week, I decided to pose it to get the discussion going.

From: Sandy To: Maths Education 1  
Date: 18 August  
Subject: Does a piece of string fix the area of the enclosed region?

An interesting suggestion came up in the lecture on Monday (10 Aug). To find the area of an irregular shape, it was suggested that a piece of string should be put around that shape and the length marked. Then the piece of string should be formed into a circular shape and the area of the circular region enclosed worked out using the formula for area of a circle.

My question to you all is: will this work? How can we find out if this is a valid way of working out the area of the first shape? What are the implications of our results?

Think about this, and please give a response - the process of reasoning, justifying your viewpoint or changing it if another explanation is more plausible, is all part of conducting mathematical inquiry. So go for it!

From: Annie Date: 19/8 8:04:53

The irregular shape could be made by pushing in some of the edge of the circle. This pushing in would decrease the area of the circle, but the length of the string, or the circumference would stay the same.

From: Hugh Date: 19/8 9:24:02

A piece of string does not fix the area of the enclosed region. Think of it like this:

If you measured two squares (which are alike except for a smaller 'square' missing portion of one square) with a piece of string. Then placed that string in a circle, the area would be the same. However, the area is obviously not the same is it?

If I served the same two square 'pieces of cake' to two 12 year old children would they complain? Yes, because the area of one is larger than that of the other.

Why is the area not the same?

How do you put it in words?

From: Harriette Date: 20/8 15:20:14

Imagine that you have a piece of string that's 40cm long and you make about 5 shapes out of it. Use all of the string every time and don't change the length, so that when the shape is finished the two ends meet. If you do all of these, the string can only cover 1 area, regardless of the shape. The only reason the area would change is if only some of the string is used etc.

From: Jenny Date: 24/8 10:42:35

I understand that the size of a piece of string does not directly effect the area of a shape but am curious about how a teacher could explain this to a student. To them it would seem logical that the area could be calculated by using a piece of string to get the circumference and then working out the area by using a formula, as I am ashamed to say it did to me when I first attended the lecture.

From: Hua Date: 24/8 10:53:17

yes, this does measure the required area. it seems though that if tertiary education students can't grasp this concept as i had trouble with as well , how do we explain it to children who are struggling with maths in a general basis.

Maybe the way we do it is to demonstrate the process by measuring standard size objects like squares and rectangles and circles that have the same area and then apply it to larger, more difficult things.

From: George Date: 31/8 8:27:16

I know it's been a while but this is the first chance I've had to go through the forum to answer this question since I brought it up in the lecture.

I don't think my brain was switched on fully that morning, but I guess that my thoughtlessness in suggesting same perimeter = same area has given us all something to think about.

I did realise moments after I made this suggestion that what I said couldn't possibly be right. Here's how I realised my mistake:

Imagine having 8 matches and forming them into a square, each side having a length of 2 matches. This area can be seen to be made up of four smaller squares, each side having a length of 1 match.



Sarah's question generated numerous responses and a fruitful discussion sharing ideas on teaching using workstations was generated. Some of the responses indicated that students were eager to use each others' suggestions.

The above are only a few of the examples of the diverse way the Q&A forum was used. In the next section the benefits of such a forum and the issues arising from its use are discussed.

### DISCUSSION

The Q&A forum had much to offer in the way of collaborative knowledge construction. Students valued their peers' opinions and developed their ideas both about mathematical concepts and about teaching these concepts. The input from other students was valued and it was clear to students when that input was authoritative. So the Q&A forum was instrumental in developing a community of learners. The role of the teacher here was to set up some of the problems, to ensure that conceptual understanding of content was being developed, and to act as an observer of the activities, only stepping in when absolutely required.

However, an issue regarding participation needs to be considered. Although the forum was used regularly and was found to be extremely useful to many of the students, there was also a large number of students who did not access the forum at all. In the evaluations of the forum, these students gave reasons for not accessing the forum as not enjoying using this technology, not having time or not seeing the need for it. These reasons need to be respected and I believe that unless students can see value in using a particular approach to learning, that they should not have to use that approach. This suggests that those students who prefer to interact in other ways should be encouraged to do so and alternative ways of learning should be provided in all subjects. A respect for individual differences is central to ideas of effective education.

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