

Knowledge Exchange: A Discussion Board System Tailored for Teaching-Learning Settings

Omar Hasan¹, Jim Waters², Bruce W. Char³, and Michael E. Atwood⁴
Department of Computer Science^{1,3} / College of Information Science and Technology^{2,4}
Drexel University
Philadelphia, PA 19104, USA
oh23@drexel.edu¹, jw65@drexel.edu², charbw@drexel.edu³, atwood@acm.org⁴

Abstract

Discussion board systems are often used in teaching-learning settings to support discourse between students and instructors. However most existing discussion board systems are generic and built to be used in a variety of domains. They do not cater for the specific needs of teaching-learning settings. One significant shortcoming is that they do not recognize that in a teaching-learning setting there are two distinct and very different types of discussions namely, instructor-student discussions and student-student discussions. In this paper we review some of such existing discussion board systems. We then introduce and examine Knowledge Exchange, a new discussion board system that we have developed. Knowledge Exchange incorporates the distinction between instructor-student discussions and student-student discussions. The Knowledge Exchange system has been evaluated by a user study, which suggests that students prefer this approach.

1. Introduction

Discussion board systems are often used in teaching-learning settings. Primary examples of such teaching-learning settings are the courses administered at universities and colleges. Discussion board systems provide a platform for students and instructors to have discourse in addition to that during classroom and office hours. Some benefits of discussion board systems are as follows (the list is not comprehensive):

a) A discussion board system provides an asynchronous medium of communication. Instructors and students do not need to be available simultaneously to have a discussion. Instructors / students can post answers / questions at times convenient to them. This also makes discussion board systems less intrusive than face to face meetings or telephone calls, which are

difficult for instructors to entertain beyond office hours. An alternative asynchronous medium is email, but one-to-one email correspondence lacks the other benefits that discussion board systems offer.

- b) By posting their question on a discussion board, a student may receive answers from several individuals (including instructors and students). This way there is a better chance that the student will find an answer that satisfies them.
- c) In absence of a discussion board system, an instructor may be asked the same question by several students (particularly by email). Replying to all those students separately is quite inconvenient for instructors. A discussion board system makes the response of an instructor to a question available to all students. If other students happen to have the same question, they can just look up the answer on the discussion board instead of approaching the instructor.
- d) A discussion board system preserves the knowledge of an instructor that they contributed to it. Therefore even if an instructor leaves an organization, some of their knowledge is still retained. This concept has been discussed in detail in the area of “Organizational Memory” ([9], [11], [1]).

Several discussion board systems exist which have been or are being used in teaching-learning settings. Some typical systems include the discussion board of the Blackboard Learning System [13], Discus (Discus / Discus Pro) [5], Answer Garden [1], Experts-Exchange [7], Usenet [8] and the discussion board of WebCT [12].

2. The problem with using the existing discussion board systems in teaching-learning settings

In this section we first highlight a salient characteristic of discussions in teaching-learning

settings. Then with the support of examples, we show how the discussions in existing discussion board systems lack this characteristic.

2.1. A salient characteristic of discussions in teaching-learning settings

We recognize that two distinct types of discussions take place in a teaching-learning setting, namely instructor-student discussions and student-student discussions.

2.1.1. Instructor-student discussion.

This type of discussion generally takes place in formal settings such as in the class, office hours or tutorials. The discussion is often formal. The information given by the instructor to the students is normally significant, definitive and referable.

2.1.2. Student-student discussion.

This type of discussion takes place among fellow students and is far less formal than instructor-student discussions. This type of discussion lets students ponder upon and assimilate the information given to them by the instructor. The key distinctions are: a) the instructor-student discussion presents the students with new information whereas student-student discussion additionally helps in digesting it, and b) the information given by the instructors is significant, definitive and referable whereas the student-student discussion may not always be so significant.

These two types of discussions are separated from each other in teaching-learning settings. This separation is advantageous because each type of discussion serves a different purpose.

A point to be noted is that the topic discussed in an instructor-student discussion is usually the topic discussed in student-student discussions that follow. So although the discussions are separate, there is a strong connection between the two.

2.2. Model of discussions in existing discussion board systems

The existing discussion board systems do not strive to make a clear distinction between the two types of discussions described above. The contributions of all users, whether instructors or students, are all grouped together.

One of the reasons for the existing discussion board systems to use this model is that they are oriented for domains which have discussions between only one pair of user types. For example:

a) User Groups, where the discussion is only member-member. Every member has an equal

status. Some users may have more powers such as the power of moderation, but those powers are only administrative. The higher status does not elevate the significance of the content of the user's postings.

b) Help Desk Groups, where the discussion is primarily expert-user. The users seek help, which is provided by the experts.

However as discussed previously, the discussions in teaching-learning settings take place between two pairs of user-types, that is instructor-student and student-student.

Since the model employed by the existing discussion board systems misses a salient characteristic of discussions in a teaching-learning setting, the following problems arise when these systems are used in a teaching-learning setting:

a) The information posted by the instructors loses its significance, since it gets surrounded by a myriad of insignificant information.

b) It becomes difficult to locate the definitive postings of the instructors in the cluster of postings by both instructors and students.

c) Students are on the same platform as the instructors, so they hesitate to communicate as freely as they would in independent student-student discussions.

2.3. Illustration of the problem in some existing discussion board systems

We illustrate this problem in some of the existing discussion board systems that we mentioned earlier.

2.3.1. Discussion board of the Blackboard Learning System.

In Figure 1, which displays a discussion in Blackboard, it is impossible to differentiate between the postings of instructors and students.

<ul style="list-style-type: none"> ▣ relevance <li style="padding-left: 20px;">Good, if I were an IR system des... <li style="padding-left: 20px;">Re: relevance <li style="padding-left: 20px;">weights ▣ orthogonal <li style="padding-left: 20px;">▣ Re: orthogonal <li style="padding-left: 40px;">Re: orthogonal <li style="padding-left: 20px;">taxonomy <li style="padding-left: 20px;">ad hoc (in general) <li style="padding-left: 20px;">ad hoc (as an IR task) <li style="padding-left: 20px;">user profile ▣ Filtering <li style="padding-left: 20px;">Re: Filtering ▣ Binary Weights <li style="padding-left: 20px;">▣ Re: Binary Weights <li style="padding-left: 40px;">Re: Binary Weights ▣ What is an index term? <li style="padding-left: 20px;">Re: What is an index term? <li style="padding-left: 20px;">Weights 	<ul style="list-style-type: none"> Loranger Jr., Timothy Drott, Carl Drop, Daniel Pine, Kathy McEachron, Donald Marschka, Megan Bitonti, Matthew Davis, Steven He, Bing He, Bing Marschka, Megan Morgan, Siana Drop, Daniel Monakey, Mark Drop, Daniel Sivakumaran, Sujatha Saakyan, Alexandra Drop, Daniel Drop, Daniel
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Figure 1. A discussion in Blackboard.

2.3.2. Discus (Discus / Discus Pro).

In the Discus screen shown in Figure 2, the first row contains a question by the user ‘Claudio’. 10 postings follow the question. There is no clear distinction between the postings by experts and the postings by non-experts.

Even if each of the postings is labeled as by an expert or a non-expert, the expert answers would seem to be lost in the numerous answers displayed linearly.

Author	Message
匿名者 Claudio Rating: ★★★★★ Votes: 1 (Vote)	Posted on Sunday, November 26, 2000 I moved a subtopic to another t click on it, I can't see any mes I also tried to regenerate the st Where am I wrong ? Can I recover the messages in Thanks (Ver. 3.10.2a Pro)
匿名者 Dan Packard, The Portland Radio Guide Rating: N/A Votes: 0 (Vote)	Posted on Sunday, November 26, 2000 I just ran into a similar problem show up. All that shows when PRO. An example of a moved subtop Thanks in advance for any help
匿名者 Kevin W. Paulisse (Paulisse) Rating: N/A Votes: 0 (Vote)	Posted on Monday, November 27, 2000 I will investigate the problem. S I visited the URL above -- topic "154.html" in the old topic that One additional question: How I
匿名者	Posted on Monday, November 27, 2000

Figure 2. A discussion in Discus.

2.3.3. Answer Garden (Answer Garden / Answer Garden 2).

The Answer Garden 2 [2] screen in Figure 3 displays a list of questions and answers about “Connection Issues” in dial-up Internet Access. The question “Connection Hangs -- What do I do now?” has three answers, each phrased “Re: Connection Hangs -- What do I do now?”. There is no way of telling which answers are by experts and which ones are by non-expert users. Imagine having 15 or 20 answers to a question. The answers by experts would be difficult to locate and would lose their significance in the multitude of answers.

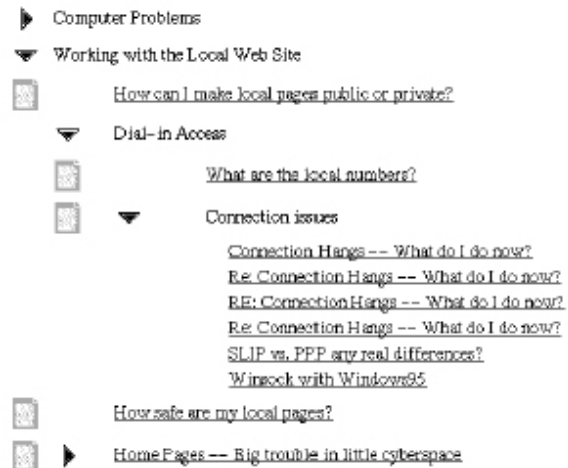


Figure 3. A set of questions and answers in Answer Garden 2.

2.3.4. Experts-Exchange.

The Experts-Exchange screen in Figure 4 shows a question by the user ‘ottob’ and the discussion that follows it. In this system too, there is no separation between the postings of experts and non-experts.

There is actually no clear distinction between experts and non-experts in the first place. Users who have proven themselves as helpful to other users are regarded by fellow users as experts of varying degrees. This system is therefore not a true reflection of teaching-learning settings where the roles of instructors and students are clearly distinct.

Please also note that some of the postings such as the one by ‘conick’ and the second one by ‘heyhey_’ are not useful contributions but rather add noise. These postings are clumped together with the more significant postings.

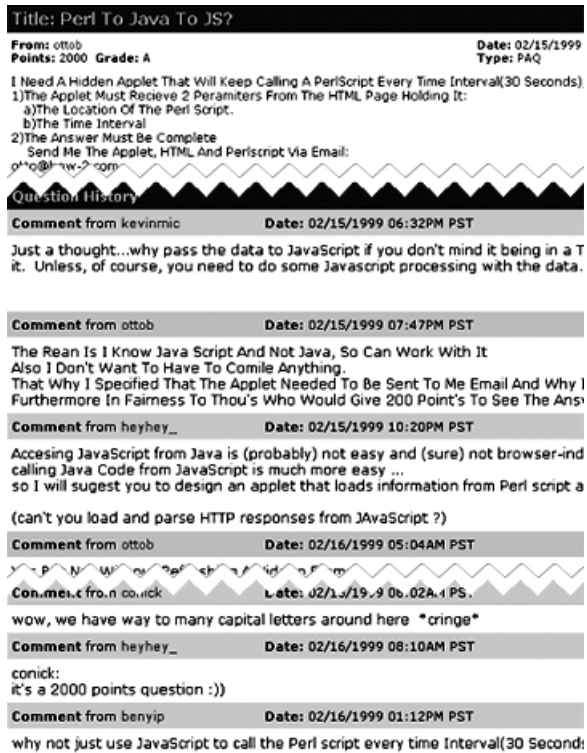


Figure 4. A discussion in Experts-Exchange.

It should be noted that although we point out a weakness of these systems in teaching-learning settings, we do not discount their overall usefulness.

3. Introducing the Knowledge Exchange discussion board system

Knowledge Exchange is a discussion board system tailored for educational purposes. Its function is to complement teaching-learning settings where there are two distinct roles: the instructors who impart knowledge and students who seek knowledge.

The key characteristic of Knowledge Exchange is that it incorporates the distinction between instructor-student discussions and student-student discussions. We will present the benefits of this approach in Section 4. The current section presents a basic description of the system.

In Knowledge Exchange the students can post questions, which can be answered by the instructors as well as peer students. The instructors can also post questions to either seed the system or as stimulus for the students.

The information posted on Knowledge Exchange is stored in a permanent database and remains available for future reference. The collection of knowledge

(knowledgebase) in the system grows as more questions and answers are posted.

3.1. Organization of information

In Knowledge Exchange information is organized under a tree-structured hierarchy of topics. The topic hierarchy can be created and modified over time by the instructors.

The main subject is represented by the root topic, which is the ancestor of the rest of the information in the tree. The design of Knowledge Exchange does not tie it down to a particular subject therefore it can be used for any subject area.

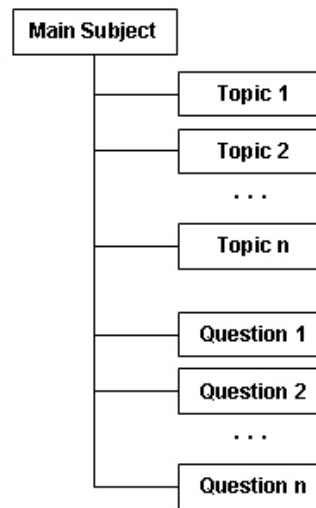


Figure 5. Structure of information under the root topic (the main subject).

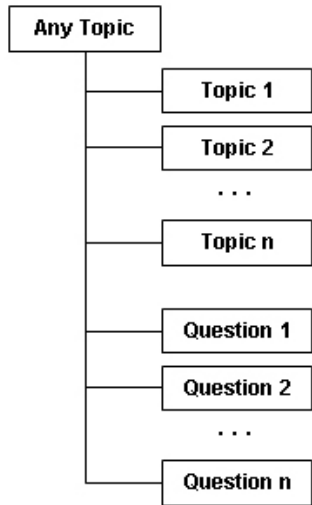


Figure 6. Structure of information under any topic.

Each question ideally exists under the most relevant topic. One way to accomplish this is to encourage the users to post a question under the topic they consider the most relevant to that question. The instructors have the ability to move a question from one topic to another topic when they feel that it is not under the most relevant topic.

A question contains three folders: ‘Answers from Experts’, ‘Answers from Peers’ and ‘Follow-Up Questions’.

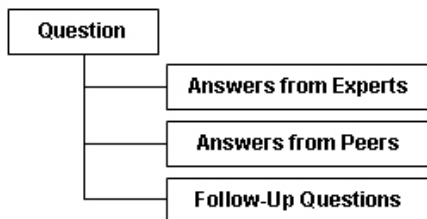


Figure 7. Folders under a question.

The ‘Answers from Experts’ folder contains any answers to the question that have been posted by the instructors. The ‘Answers from Peers’ folder contains any answers to the question that have been posted by the students. The ‘Follow-Up Questions’ folder contains questions that are spawned in response to the answers to the original question. The questions in the ‘Follow-Up Questions’ folder, are themselves full-fledged questions.

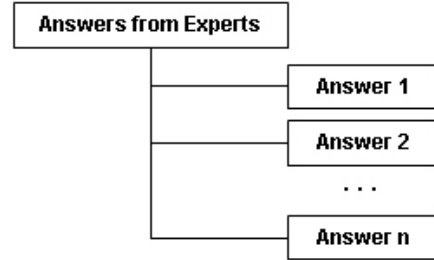


Figure 8. Structure of information under the ‘Answers from Experts’ folder.

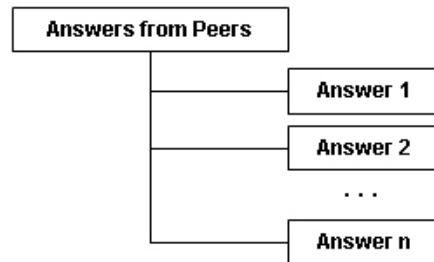


Figure 9. Structure of information under the ‘Answers from Peers’ folder.

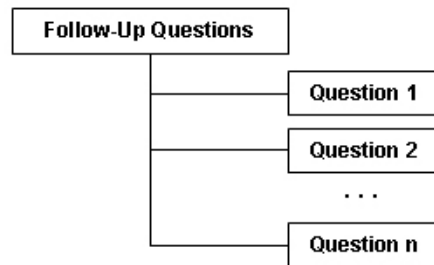


Figure 10. Structure of information under the ‘Follow-Up Questions’ folder.

3.2. Using Knowledge Exchange

The subject in the deployment of Knowledge Exchange used as an example in this section is Object Oriented Design.

3.2.1. Finding information.

Users have the option of using three different methods for finding the information that they need: By browsing, by performing a keyword search or by looking under the specialized folder ‘Recently Posted Questions’ which contains links to the questions that have been posted in the past seven days.

Knowledge Exchange

The screenshot shows the Knowledge Exchange interface. On the left, there is a search box with a 'Submit' button and a 'Links' section containing 'Home', 'Help', and 'About'. On the right, under the heading 'Object Oriented Design', there is a list of 'Recently Posted Questions' with various topics and their respective counts (e.g., 'Class Project based on Class Design' [F: 0, Q: 0]).

Figure 11. Three different methods for finding information in Knowledge Exchange – browsing, searching, and looking under the ‘Recently Posted Questions’ folder.

3.2.2. Looking at questions and answers.

Selecting a question, presents the user with the option to look at the answers posted by the experts, the answers posted by peer learners or follow-up questions. The page also displays other information such as the user ID and the name of the person who posted the question and the date and time of posting.

The screenshot shows a question display page. The question text is: "I'm confused on how to implement the abstract 'Response' hierarchy that we modeled in class. The hierarchy had a base class and two subclasses - stringResponse and numericResponse. I'm working on the assumption that each of these classes would have a data member that contains the actual response, let's call it 'res'. For Numeric, that member would be an int and for String it would be a string. So how do I create one 'getRes' function, in the base class, that would return both types of res? Based on my very limited understanding of Abstract classes, I cannot change the return type of a pure virtual function. Any suggestions/guidance would be appreciated." Below the question, there is a 'Posted By:' field with a user ID and a timestamp: "Wed Jul 16 09:42:31 EDT 2003". At the bottom, there are three links: "Answers from Experts [A: 1]", "Answers from Peers [A: 4]", and "Follow-Up Questions [Q: 0]".

Figure 12. A “question display page” in Knowledge Exchange.

The answer display page displays the text of the question, the text of the answer, the name and user ID

of the person who posted the answer, the date and time the answer was posted and whether the answer is by an instructor or a student.

The screenshot shows an answer display page. The answer text is: "An abstract class is a class that can't be instantiated (we can't create an obj methods pure virtual. A pure virtual method is a method that is not implemented for its derived classes to implement that method. A pure virtual method has: Return_type method_name(arguments) = 0. As your StringResponse and NumericResponse. One of the main advantages of using abstract class inst can have a vector of abstract class type and this vector can hold a mixture in the case of a template, if you make Response class a template class and StringResponse, you can't have a single vector that holds both NumericResponse for abstract class and define the minimal methods in this class that are c". Below the answer, there is a 'Posted By:' field with a user ID and a timestamp: "Wed Jul 16 16:59:24 EDT 2003".

Figure 13. An “answer display page” in Knowledge Exchange.

3.2.3. Asking a new question.

If the information that a student needs is not available in the knowledgebase, he/she can ask a new question. It is recommended that a new question be asked under the most relevant topic in the topic hierarchy. This gives the new question accurate context and also makes it easier for other users to locate it.

If the instructor's answer does not satisfy the student, he/she can ask a follow-up question to the previously posted question. Follow-up questions are directed primarily towards the instructors.

3.2.4. Answering a question.

Instructors and students can post answers to a question. The answers posted by instructors are placed in the question's 'Answers from Experts' folder whereas the answers posted by students are placed separately in the question's 'Answers from Peers' folder.

3.3. Maintaining the knowledgebase

The instructors have exclusive access to the functions of Knowledge Exchange that enable maintenance of the underlying knowledgebase. The maintenance functions include editing the text of an item, deleting existing items, moving items, and creating new topics.

3.4. Architecture and technology used

Knowledge Exchange is a web-based multi-tiered system built with Java, JSP, JavaScript, HTML and SQL. Extreme programming [3] practices were used for its development.

4. How does Knowledge Exchange address the problem?

Knowledge Exchange makes a clear distinction between the two types of discussions that take place between instructors and students. Although it makes this distinction Knowledge Exchange appreciates that a strong connection must still be maintained between the instructors and students and the two types of discussions that take place between them just as is the case in teaching-learning settings.

The postings of instructors and students on a question are placed in either one of the three folders under the question.

The 'Answers from Peers' folder simulates the student-student discussions. All student postings on a question (except for follow-up questions) go under this folder. The range of postings can include answers to the question, comments on the answers or the question, further questions for the students participating in the discussion; essentially anything that is said by students in a student-student discussion. The postings may be very informal, the instructors do not interfere with these postings giving the students full freedom for discussion. This is a close reflection of actual student-student discussions.

The 'Answers from Experts' and the 'Follow-Up Questions' folders simulate the instructor-student discussions. The postings of the instructors are placed in the folder 'Answers from Experts'. Since the postings are separated from the postings of the students, they command the higher significance that they deserve. A user looking for an accurate, significant, definitive and referable answer to a question does not have to look beyond this folder. This approach is representative of actual instructor-student discourse. In case a student is not satisfied by the answers posted by the instructors, he/she can post follow-up questions for the instructors.

A strong connection between the two types of discussions is maintained since the topic of discussion (the question) is the same.

5. User study

A user study was conducted to evaluate the system.

5.1. Subjects (users)

The subjects were the 59 students of an Object Oriented Design course administered at the Computer Science department of a North American university. The course was divided into two sections, each section with approximately an equal number of students (Section A: 29, Section B: 30).

The majority of the subjects had extensive prior exposure to many existing discussion board systems including Blackboard and WebCT.

5.2. Method

For each section a separate copy of Knowledge Exchange was deployed. The purpose of deploying a separate copy for each section was to keep the experience of the users of each section independent from the other.

Each student was given a written set of instructions as to how to use the system. Students were also given a verbal description of the system in a classroom session. The hypothesized benefits of the system were explained.

After the system being available to the students for approximately 6 weeks, we conducted a paper-based user survey. Students were asked their opinion on the following two statements.

- a) Current discussion board systems do not closely mirror the format of discussions that take place in teaching-learning settings. In a teaching-learning setting there are two distinct types of discussions: instructor-student and student-student. The current discussion board systems do not make this distinction.
- b) A discussion board system that makes this distinction would be more helpful in teaching-learning settings.

The students were asked to select one of four choices as their opinion about each of the two statements. The four choices were: 1) Agree, 2) Somewhat Agree, 3) Somewhat Disagree and 4) Disagree.

5.3. Results

The result of the survey on statement a) is depicted in Table 1.

Table 1. The result of the survey on statement a).

	Agree	Some- what Agree	Some- what Disagree	Disagree	Total
Section A	2 (15%)	8 (61%)	2 (15%)	1 (9%)	13 (100%)
Section B	3 (13%)	16 (66%)	5 (21%)	0 (0%)	24 (100%)
Total	5 (14%)	24 (64%)	7 (19%)	1 (3%)	37 (100%)

The result of the survey on statement b) is depicted in Table 2.

Table 2. The result of the survey on statement b).

	Agree	Some- what Agree	Some- what Disagree	Disagree	Total
Section A	2 (15%)	7 (55%)	2 (15%)	2 (15%)	13 (100%)
Section B	1 (8%)	11 (84%)	1 (8%)	0 (0%)	13 (100%)
Total	3 (12%)	18 (68%)	3 (12%)	2 (8%)	26 (100%)

The results from the two sections are similar. They both show that the majority of the students preferred the approach used by Knowledge Exchange, although there are some who did not. For an initial user study, these results are very encouraging. However we feel that for a definitive evaluation of Knowledge Exchange we need a more thorough user study.

6. Conclusion

In this paper we have argued that although discussion board systems are very valuable for teaching-learning settings, existing discussion board systems are mostly generic and not specifically adapted for this setting. We have proposed that two different types of discussions take place in teaching-learning settings, namely instructor-student and student-student discussions. The existing discussion board systems do not make this distinction and therefore do not closely reflect the way discussions take place in teaching-learning settings. Knowledge Exchange is a new discussion board system that is specialized for teaching-learning settings. It incorporates the distinction between instructor-student and student-student discussions. We have conducted an initial user study of Knowledge Exchange in a teaching-learning setting, which suggests that our approach is preferred by students.

7. Acknowledgments

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