Knowledge Exchange: A Tool for Collaborative Learning

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Abstract

In a learning environment, knowledge is exchanged between experts and learners in the form of questions and answers. Knowledge Exchange is an application that captures and preserves this knowledge as a well structured knowledge base. The learners can refer to this application for immediate access to previously captured knowledge. The experts can spend their time and effort more productively by answering only new questions. The unique strength of Knowledge Exchange is that it permits experts as well as knowledgeable learners to answer questions, which results in 1) richer content and 2) increased probability of getting timelier answers. Built on web-based and platform-independent technologies (Java, JSP, HTML and SQL), Knowledge Exchange has the capability of being widely accessible and deployable. Knowledge Exchange can be retargeted for any subject matter. The impact of Knowledge Exchange in real-life learning environments is currently being studied. Another significant feature that is being added to Knowledge Exchange is context-sensitive information retrieval.

Introduction

Consider the following problems in a learning environment:

1. The learners have limited access to the experts and therefore cannot always get help in a timely manner. A learner may be working at the weekend, late at night or physically distant and unable to gain access to required expertise.

2. The learners may not know from whom they can get the most complete and correct answers to their questions. For someone new to an area knowing the best person to ask can be as big a problem as knowing what to ask.

3. The same questions may be asked many times by different learners or even by the same learners who may quickly forget knowledge elicited from experts. This Duplicated effort is annoying for experts and wastes valuable resources.

4. An organization instantly loses the knowledge of experts with their departure. Priceless knowledge that took an expert many years to acquire can be lost quickly.

Tools have been developed that address these problems. Examples include

    Answer Garden
    Knowledge Tree
    Math Forum

These systems capture the questions and answers that arise in a learning environment and preserve them in a knowledge base. These tools however have several shortcomings:

1. They do not recognize the fact that often knowledgeable learners are also able to help their peers. Peer learners are generally more easily and quickly accessible than experts.

2. Little peer to peer discourse is possible.

3. Most of these systems are built on platform-dependent technologies and therefore are not capable of wide accessibility and deployment.

Knowledge Exchange is an application that addresses the above listed problems.
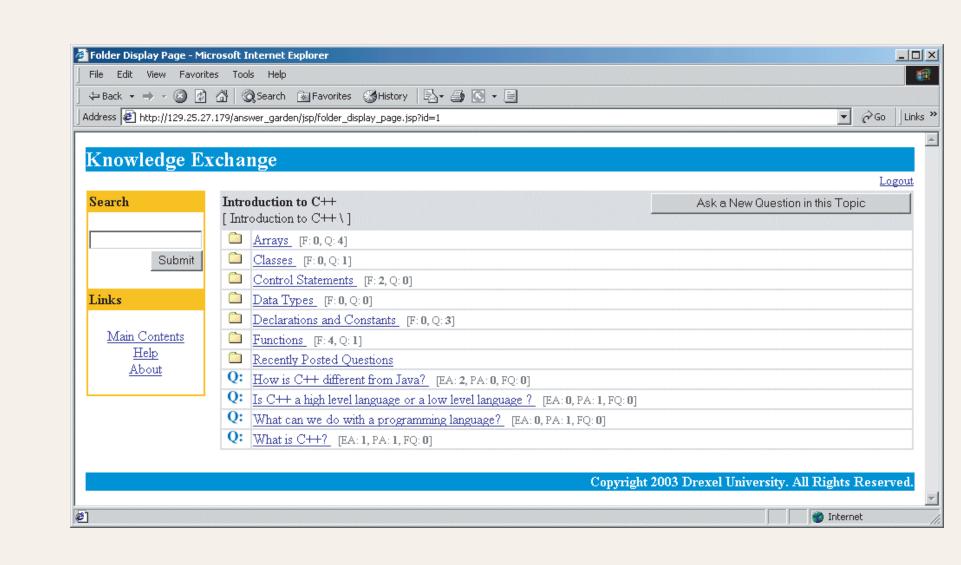
Knowledge Exchange

In Knowledge Exchange information is organized as a hierarchy of topics. Each question exists under the topic that has the most relevance to it. A question contains answers given by experts, answers from peer learners and follow-up questions generated.
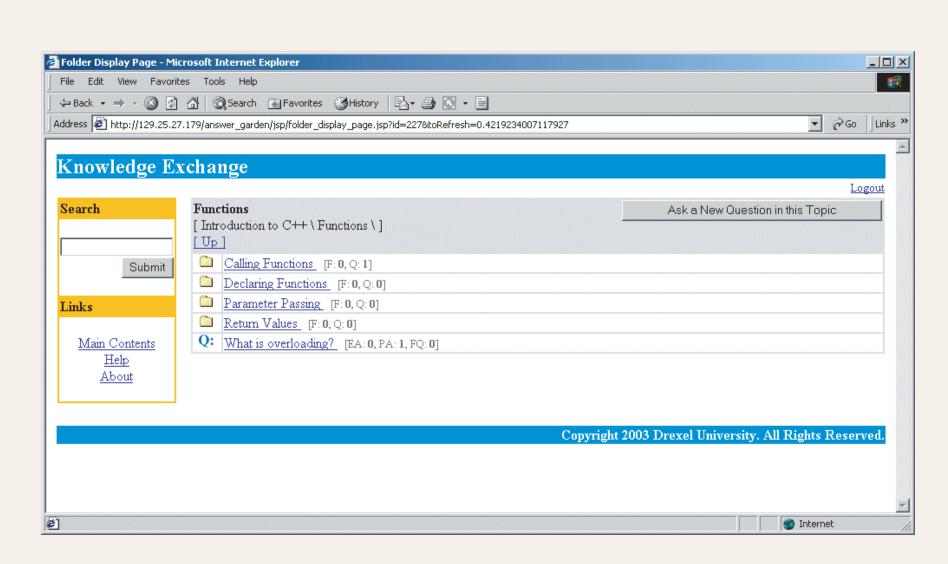
Finding Information

Users have the option of using three different methods for finding the information that they need.

1. Browse

The 'main contents' page of Knowledge Exchange presents the user with a list of topics and questions that are immediately under the main subject.

Selecting one of the topics, let's say "Functions", brings up the list of topics and questions that are immediately under "Functions".

The numbers of folders and questions that a folder contains are displayed in front of its link.
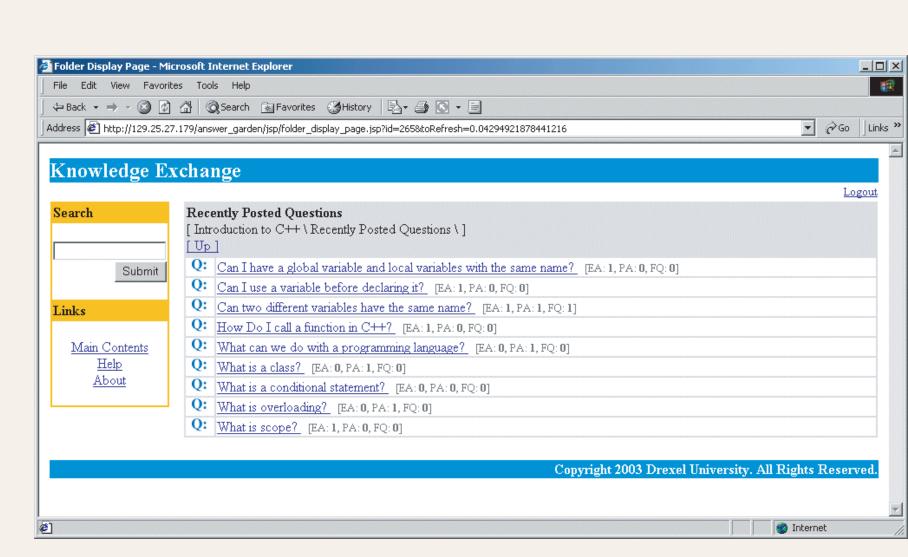
Similarly the numbers of expert answers, peer answers and follow-up questions that a question contains are displayed in front of its link.

The "Up" link on each page takes the user back to the parent of the currently displayed item.

In this manner, the users can browse the knowledgebase until they find the information that they need.
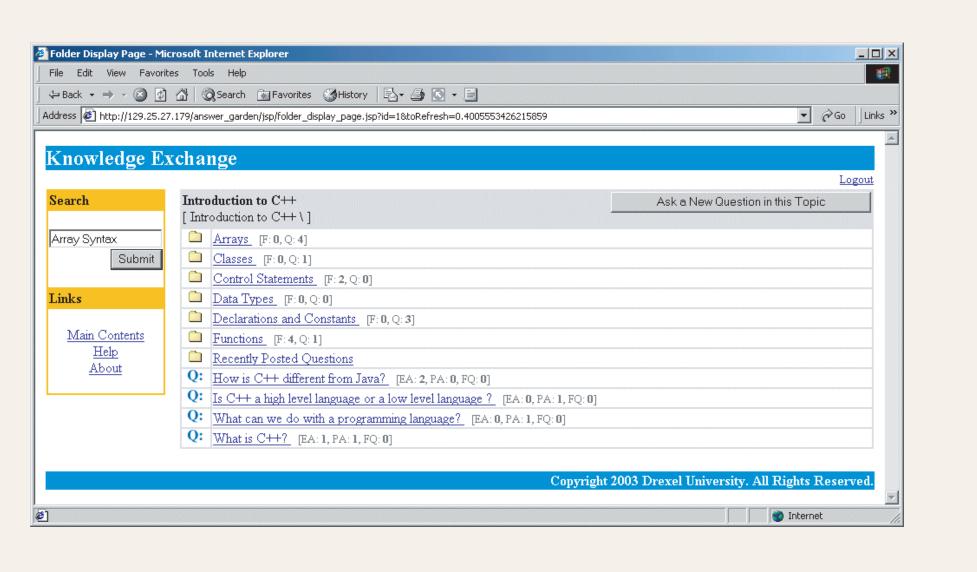
2. The "Recently Posted Questions" Folder

The "Recently Posted Questions" folder contains links to all the questions that have been posted in the past seven days. It provides easy access to recently posted questions.

3. Search

Users can search the knowledgebase using keywords. Questions containing those keywords are returned as a list.

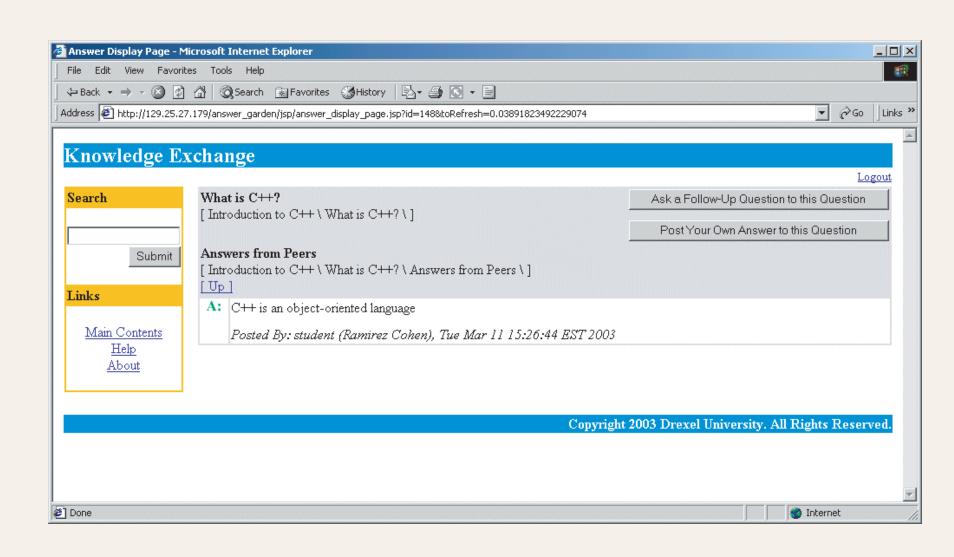The current implementation uses a conventional text-matching search algorithm.

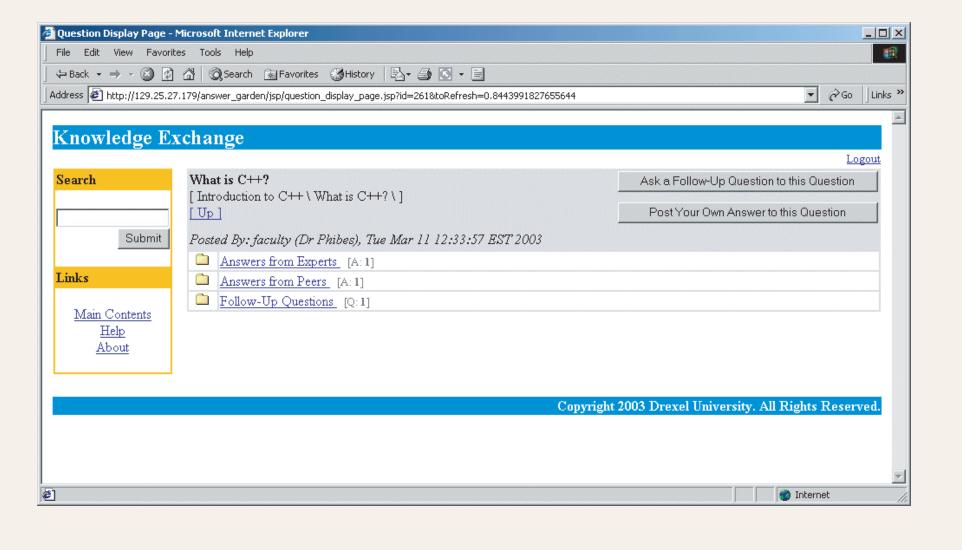### Looking at Questions and Answers

1. Questions

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.
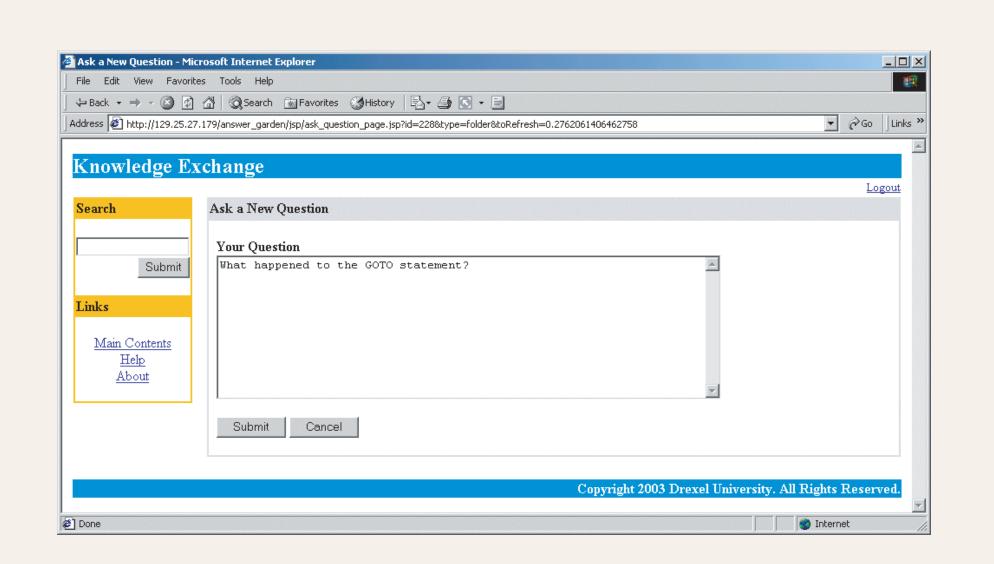

2. Answers

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 expert or a peer learner.

Asking a New Question

If the information that a user 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.
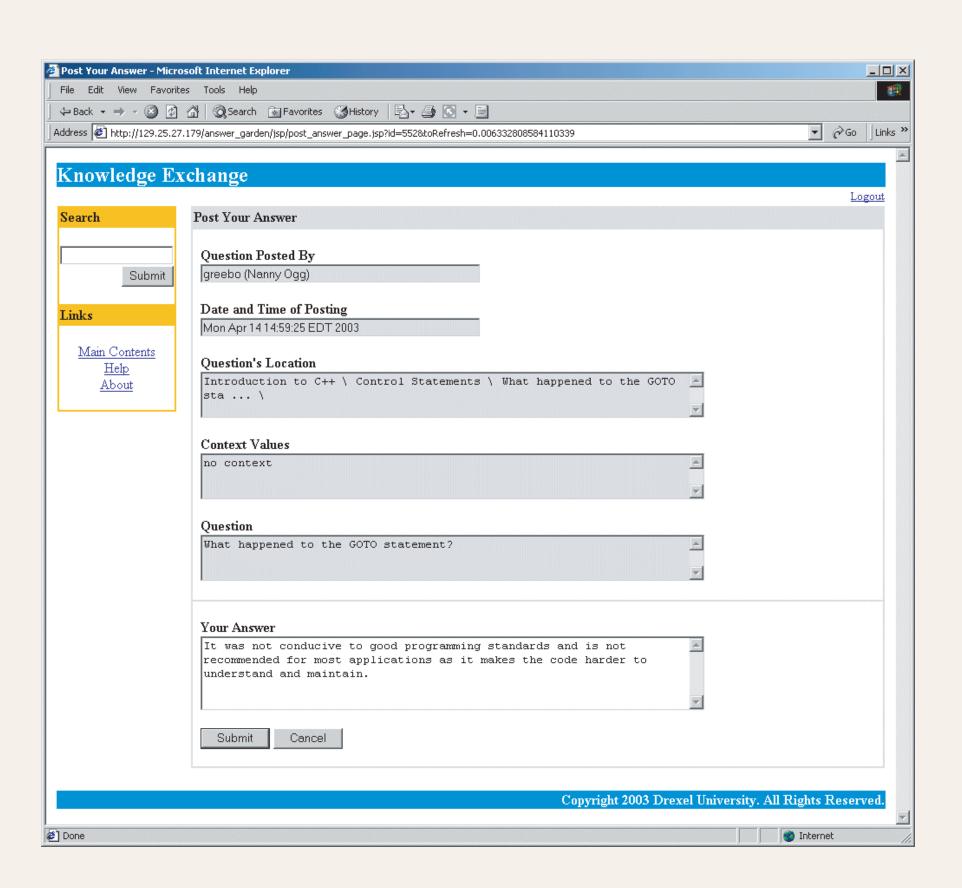
Another reason for asking a question is when answers to a question spawn new follow-up questions. In this case users can ask "follow-up questions" to a previously posted question.

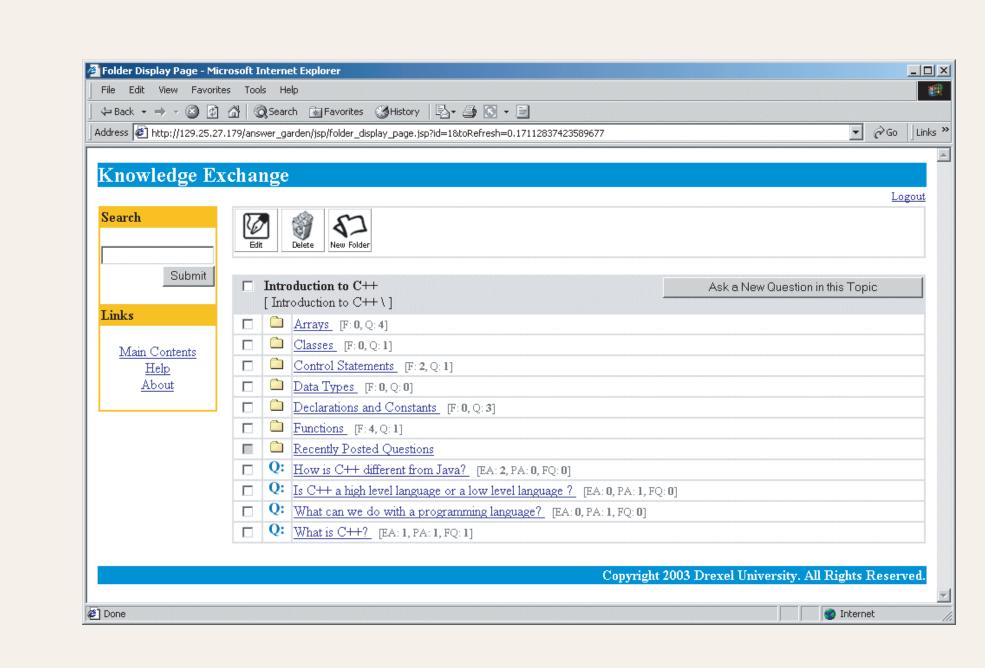The ID of the user and the date and time of posting are saved along with a new question.

Answering a Question

Experts and knowledgeable learners can post answers to a question. The answers posted by experts are placed in the question's "Answers from Experts" folder whereas the answers posted by learners are placed separately in the question's "Answers from Peers" folder.

Maintaining the Knowledgebase

The experts 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, and creating new topics.
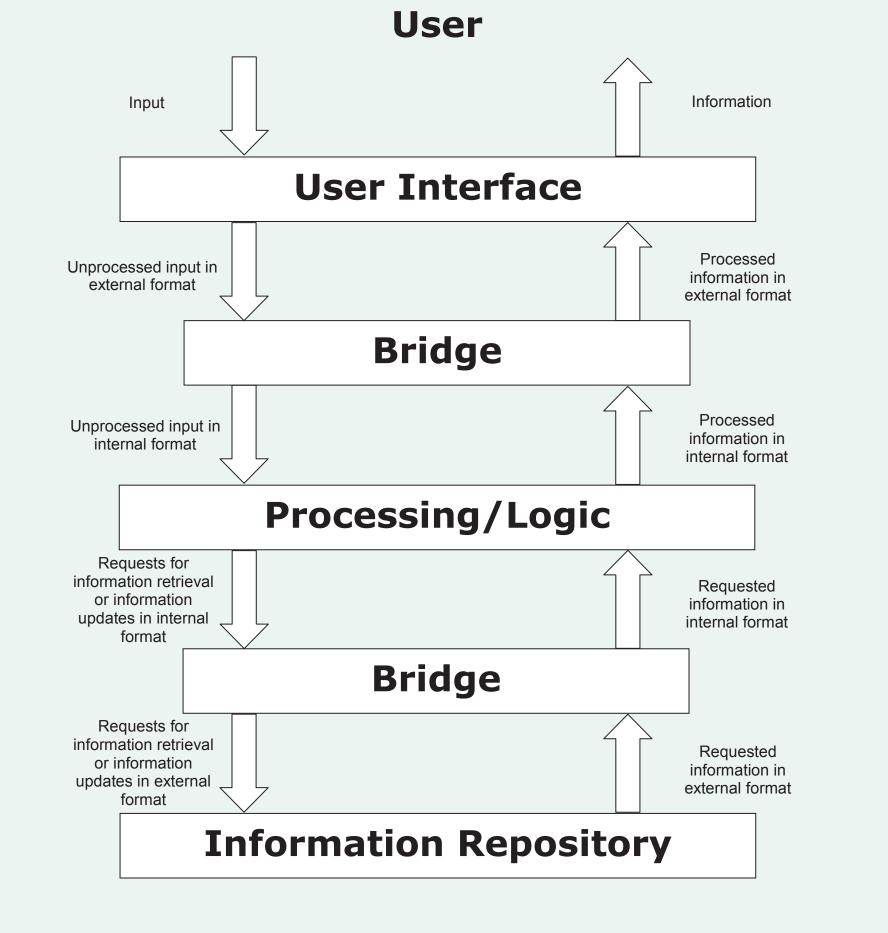

Implementation

Knowledge Exchange has been implemented with the following goals in mind:

1. It should be widely accessible i.e. not limited to a physical location such as a LAN.

2. It should be widely deployable i.e. on a wide variety of platforms such as Windows, UNIX, Macintosh etc.

3. It should be easily modifiable to accommodate advancements in technology such as the use of a new database.

Architecture

The architecture consists of three main layers and two layers that bridge them. This model allows any of the layers to be modified or replaced with minimal impact on the layers above and below.

Technology Used

The user interface of Knowledge Exchange is built with JSP, JavaScript and HTML. Since these technologies are web-based, Knowledge Exchange is accessible through any standard browser from anywhere over the Internet.

The processing engine of Knowledge Exchange is built with Java and SQL. These technologies are platform independent therefore the application can be deployed on a variety of platforms.

The Data Repository can be any modern relational database that supports SQL such as Oracle, MS Access, MySQL, SQL Server etc.

Contributions

Knowledge Exchange makes the following contributions:

1. It captures knowledge in a readily accessible repository of questions and answers, which 1) makes it quicker and easier for learners to find information and 2) lessens the burden on the experts.

2. A question posted by a learner is visible to several experts thus there is a better chance that it will be answered by the expert best qualified to answer it.

3. It preserves knowledge that would normally be lost when an expert leaves an organization.

4. The ability of learners to contribute to the knowledgebase enriches its content and allows for learner discourse.

5. Although learners are allowed to answer questions, a clear distinction between answers from experts and learners is maintained. This allows users to judge the accuracy of an answer based on its author.

6. Since peer learners are allowed to answer questions and they are generally more readily available, there is a better chance that a question will be answered more quickly. This is in contrast to the case in which a learner has to wait for an expert to become available to answer a question.

7. The information is organized as a hierarchy of topics with each question located under the topic that has the most relevance to it. This gives the question accurate meaning and context.

8. Knowledge Exchange is built with web-based and platform-independent technologies therefore it is widely accessible and deployable.

Future Research

Study of Impact of Knowledge Exchange

The impact of Knowledge Exchange in real-life learning environments is currently being studied.

Knowledge Exchange is being used to support Graduate Advising at the Department of Computer Science. Plans are also afoot to employ Knowledge Exchange for undergraduate classes.

Context-Sensitive Information Retrieval

A significant addition to the system that is currently under development is context-sensitive information retrieval.

When the knowledgebase of a system becomes large, it becomes difficult to locate the required information. For example, a simple text search on a keyword such as "arrays" may return information in several contexts including Computer Programming, Radio Astronomy and Genetics. It is time consuming and frustrating to sift through the irrelevant results to find the information that is actually relevant.

Context-sensitive information retrieval is expected to make finding information more accurate and efficient.