ABSTRACT

The internet has created a vast set of resources available from anywhere in the world, at any time. This virtual information repository also has the potential to serve as a virtual learning environment. It is the goal of this project to create an online classroom, for the purpose of enhancing the learning experience of students from three international universities: the University of Virginia, the University of the West Indies, and Mapua Institute of Technology. All three groups of students are participating in a course called Environmental Systems Analysis, the purpose of which is to teach community-based management of municipal sanitation services. The site serves as a medium for communication and collaboration for the students throughout the completion of their course project, with an overarching goal of creating lasting relationships based on trust and common experiences. It differs from previous similar projects in that it is designed with the needs of financially restricted and less technologically proficient institutions in mind.

Full-scale development of this tool was broken up into several components, including background research, users’ requirements gathering, prototype design, and testing and revision. The site has been developed using predominantly open-source technologies available to anyone with an internet connection. Additional deliverables of this project include a detailed user guide containing the specifications and requirements of the system, as well as a section detailing each of the functions within the site. The guide enables those unfamiliar with the technologies present in the website to quickly understand their uses and also serve as a guide for any university that wishes to establish its own collaborative learning program. The project is funded in part by a University Teaching Fellowship grant to Prof. Garrick Louis.

1 INTRODUCTION

The purpose of this technical report is to explain the requirements necessary for the creation and maintenance of a collaborative website and to elaborate on the issues surrounding such a website. This paper was created as part of a Capstone project whose goal was to create a scalable prototype of a website that could be used to effectively facilitate the collaborative learning process. In the context of the circumstances of this project, the objective was to create a website which would allow users from three different universities around the globe to communicate with each other about common course material.

1.1 Problem Definition

Systems Engineering 670 (SYS-670) is a course in Environmental Systems Analysis taught at the University of Virginia by Professor Garrick Louis. The material of the course focuses on community-based sanitation management, and is being taught in concurrence with two foreign universities: The University of The West Indies located in Trinidad and Tobago, and Mapua Institute of Technology located in the Philippines. SYS-670 also includes a year-long collaborative project. Each group of students is required to work within their respective communities to find a potential sanitation project, conduct research, and then communicate their findings to the other groups. The three groups of students then pick one project to work on collaboratively throughout the year to develop and implement a solution.

The purpose of this Capstone Project was the creation of a collaborative website, which will allow the three universities participating in SYS-670 class to coordinate their classroom activities and collaborate on the year-long sanitation project, with a goal of successfully completing the
course and generating a practical solution in concurrence with the other groups.

1.2 Findings

Through the development of several iterations of this collaborative website, we found that in order for a website to allow users to effectively communicate, the site needed to fulfill a number of minimum requirements. In addition to displaying static information, the site needed to provide some means for users to communicate with one another in real-time, it needed to allow users to upload and download pertinent course material, and it needed some way to maintain long-running discussions on a variety of topics. We found that all of these functions could be accomplished by using a number of different electronic means of communication, specifically: Instant messaging capabilities, file transfer protocol, and message boards.

The intended users of this type of site are not only people in affluent countries, but those in less developed countries who have limited access to the funds necessary to purchase computers and access to the internet. This indicated that cheap and accessible technologies must be used to build the site. This ensures that the website this is economically scalable - services available on this site can be expanded to easily include more users focusing on the same topic or the site could be replicated to serve an entirely new group of users focusing on a different topic, at a relatively low cost to those new users.

2 LITERATURE REVIEW

2.1 Academic Research

The term collaborative learning refers to an instruction method in which students at various performance levels work together in small groups together towards a common goal. Students are responsible for one another’s learning as well as their own. Therefore, the success of one student helps the other students succeed. The practice of collaborative learning has been in use for years with research on the topic dating back to the late nineteenth century. Extensive research has been performed on the benefits derived from the collaborative teaching model. These tests have been converted into a set of strategies for how to best conduct collaborative teaching in the classroom environment (Ng & Ma 2002). These strategies emphasize the positive gains derived from working and learning together and seek to derive the greatest value out of these experiences. Greater than 500 studies demonstrating the usefulness of collaborative learning strategies over others emphasizing competition and individual achievement have been conducted since the turn of the century (Johnson & Johnson 1989). Several studies have found a correlation in collaborative learning with improved mental health, due to increased social interaction and healthier interpersonal relationships (Johnson & Norem-Hebeisen 1981). The collaborative learning paradigm has been demonstrated in most cases to improve social skills, build leadership, foster trust, and teach students to mediate conflict, while also stimulating more creative higher level thinking (Ng & Ma 2002).

2.2 Technical Research

Several website creators have given in depth descriptions regarding the technical software and hardware specifications used for the creation of their websites. The majority of the website creators utilize off-the-shelf software packages to enable communication via the web (Brown & Duguid 1996). Some of these technologies include voice and video conferencing enabling software packages, online message boards, and document transfer software. Logistically, all of the websites fit the same form. All employ a basic client-server model, which allows the professor control of the website, while students possess unlimited navigation capabilities, but limited content revision capabilities. A server administrator possesses the most control of the website itself and its status on the server. Webb (1996) describes a number of alternative logistical configurations which he concludes are lacking. He feels that the structure described above is the most suitable for the collaborative process.

2.3 Implications of the Learning Process

The greatest difficulty that most websites faced in the facilitation of collaborative learning was balancing online course interactions with the traditional physical interactions of the classroom. When these two different interactions were well balanced, the results showed marked improvement in all aspects classroom performance and much greater confidence in the value of the online experience (Ragoonaden & Bordeleau 1993). Courses that lacked this balance did not contribute to the learning process. Courses that depend heavily on online interactions must make every effort to create tools and functions that replicate the face-to-face interactions with professors and other students as closely as possible: a key to forming an effective collaborative environment.

Several of these collaborative websites incorporate globally distributed learning (Cogburn 2002). One specific collaborative web-based project involved groups from America and South Africa. Although this project was not conducted over an extended length of time, nor dealt with very in-depth online tasks, it did show great success in the collaborative tasks its students were required to perform. One of the major issues when dealing with a collaborative website in a less developed country is the issue of technology training. Before attempting to be-
gin use of a virtual classroom, there is a great need to train the students so that they feel comfortable with the technology that is driving their collaborative learning experience. Assurance that each student is comfortable with the technology increases the probability of successful adoption of the collaborative website as a motivational and beneficial part of the overall learning experience (Cogburn 2002). A group project which forces students from the different sites to interact with each other on a regular basis is very crucial in truly creating online communities. These communities must be reinforced by a social aspect of the website, which strengthens trust and helps create relationships the same way they would in person-to-person contact (Cogburn 2002).

3 WEBSITE CONSTRUCTION AND CONTENT

Full-scale development employed top-down systems lifecycle that took into account background research, users’ needs, prototype design, testing, and revision. The systems methodology process below explains how decisions regarding website content were made.

3.1 Determine the Goals of the System

- Facilitate distance learning by providing a friendly and easy-to-use web-based environment in which collaborative learning may take place
- Create a low-cost system that can easily be distributed and connected participating schools in various countries
- Include functionality such as a bulletin board system, upload/download capabilities, logon/logout function, user hierarchy, video conferencing/instant messaging

3.2 Establish Criteria for Ranking Alternative Candidates

- Cost
- Efficiency
- Simplicity of Use
- Maintainability
- Compatibility with hardware/software system requirements
- Popularity (do people already know how to use the program?)

3.3 Hardware Requirements

In order to support a collaborative learning website, the user needs a number of pieces of equipment. The major requirements for such a system are: an internet connection, a computer and monitor. Most previous research emphasized the need for face-to-face communication for effective collaborative learning, so additional technologies, such as a web cam, must be purchased to support this feature. This equipment can be purchased at a relatively low cost to the user, with costs ranging from $50 to $200.

The bandwidth of the internet connection can limit the quality of data sent and received by the user. In order to accommodate all users, the site needed to be designed with specifications that can function using a relatively low bandwidth, limiting the site to basic multimedia content. Nearly any computer designed in the last five years can support internet content, so although this is a concern, assumptions can be made as to basic specifications.

3.4 Software Requirements

The prototype was designed with the intention that students who do not have access to expensive computing resources may use it. The numbers of software options available for the design of the prototype were unlimited. We initially looked at three programming languages Personal Homepage Protocol (PHP), Active Server Pages (ASP), and ColdFusion. We initially ruled out ColdFusion because of our financial restrictions. It is extremely expensive to buy a license to run ColdFusion on your server - approximately $3,000 to $5,000.

This left us with PHP and ASP. We chose to use PHP over ASP for many reasons. First, PHP is free. Often with ASP you need to buy additional components in order to complete certain tasks. Second, PHP integrates with MYSQL (our database language) perfectly. The two languages were designed to work together. Third, in most instances PHP documents run faster than ASP documents. This is something that matters to Universities using this site that have a slow internet connection. Forth, PHP programming is much closer to C++ programming, a language that we are familiar with. Finally, PHP is an open source programming language. An open-source protocol allows the site to be copied and revised at will to suit the user’s needs, and the necessary software to do this can be attained at no cost. There are a number of open-source protocols available which all vary slightly in form and function. In order to host these programs, some cost is involved to the user, but this option is still far cheaper than using a proprietary programming language such as ASP.

3.5 Layout

In order to provide a clean and attractive interface with which the users could interact, we chose to use a limited color scheme to avoid confusing the user. All relevant information about user schools and countries was provided on a banner which remains static on the left side of the page, as well as the user login status to the system.
The all of the major features of the site can be accessed via the buttons located at the top of the main viewing section. This layout is maintained throughout the entire site in order to provide continuity of feel for the user. The following figure is a screenshot of the home page.

![Screenshot of login.html](image)

**Figure 1:** Screenshot of login.html

### 3.6 Access and Security

The majority of features of this site are intended to be used only by students participating in the Environmental Systems Analysis course at one of the three participating universities. Therefore the system needed to have a system to limit access to outside users. Each student is given a default login name and password to access the site. This allows the user access to all features of the site. A special user name and password is provided to the professors teaching the classes, which grants them special privileges within the site.

If the user inputs an incorrect user name and password combination when attempting to login to the system, it provides an error message indicating as such and directing the user to log into the system again. When the user is logged into the system, the system indicates as such on the left side of the page. This login status is present throughout the entire time a user is logged into the system.

### 3.7 Multimedia Content

The internet is a limited tool for communication, so extra steps must be taken to reinforce the relationships that develop between the users. All prior experiences have indicated that unless the users feel that they have something invested in the relationships with different users from different locations they will not be motivated to make meaningful contributions to the process. Each of these different groups of users has a very different background, so the intent of the information provided within the website is to help the groups to understand each other. If the users understand their peers, it helps them to feel more invested in the online relationships and the learning process. It is only in the context of understanding that productive interaction can occur, so this information is very valuable to the users and to the collaborative process itself. The site provides information about each country, its history, and people. Information about current events in each country is provided to help the users understand the others’ situation within their countries. It is hoped that current knowledge of events within a culture at the will help the users to place others’ thoughts and actions in the proper context.

### 3.8 User Profile and Information

Each user is provided a default user profile when they are granted a user name and password to the system. If user chooses to change his or her information, the *Edit Profile* section of the site allows the user to change this information and enter in new information. This information includes: first name, last name, phone number, Microsoft Messenger Service screen name, and email address. This information can be changed at any time.

If a user wishes to view the contact information of another user, the site provides the *Contact Information* section which allows a user to select students by school or the professors to view the contact information of all selected groups. These sections give users the ability to contact each other to collaborate on course work or project information.

### 3.9 File Transfer

The ability for users to be able to both upload and download documents to and from the site is very important in facilitating the collaborative learning process. To serve this purpose the system is designed with two sections: *Upload Files* and *View Files*. The *Upload Files* section allows any user to upload files of four types: a homework assignment, a syllabus, a class lecture, and a project file.

The *View Files* section allows any user to view available files of any of the aforementioned types, broken down by school. Students can only view files from their schools sections, with the exception of the collaborative project, which is a communal folder.

### 3.10 Material and Document Review

The traditional collaborative process emphasizes the review and critique of participants work by others in order to generate a number of opinions and learn from others. This is necessary to ensure that a participant’s work satisfies the needs of all users. This website is intended to
support collaboration on a water resource management project. This requires the generation of a number of documents and materials including statement of problem, requirements documentation, initial drawings, schematics, transcripts of communication, and any number of other materials, which need to be available for viewing by all participants in the course. This requires some forum to allow the users to upload and download these documents in order to effectively review and critique them, as well as to clearly understand the needs and progress of the project.

3.11 Real-Time/ Face-to-Face Communication

Real-time communication is the most important aspect of any form of communication in which users wish to interact normally. Forms of communication that lack the aspect of real-time can be effective means of communicating ideas and opinions, but cannot replicate the interactive aspect of a face-to-face conversation. This interactive quality is the key feature we wished to capture in order to stimulate a vibrant discussion of the course material. The classroom environment provides constant face-to-face interaction, bringing together a number of students into the same setting to relate to one another. Any conversation lacking face-to-face communication loses many of the qualities that allow people to effectively communicate their points of view. Non-verbal communication in the form of facial expressions and hand movements form a key part of our interactions by communicating subtle changes in emotion and understanding. Digital communication lacking face-to-face communication does not allow for the effective transmission of ideas and can be lacking in richness. In addition, face-to-face communication can help make an online user feel more invested in the relationships with other users, allowing them to derive more satisfaction out of the learning process.

To facilitate the real-time/faceto-face communication we added chat and video conferencing sections to the website.

When considering what instant messaging service we should make part of our system. We looked at some of the ones that were already developed and easily available: AIM, MSN, Yahoo!, and ICQ. All of the services were free, and relatively similar in nature and functionality. Considering that most of us are more familiar with AIM and MSN, we focused on those two. Although most Americans are more comfortable with AIM, MSN is more widely used internationally. Both have features that make them more appealing. AIM gives you access to its service at any time from any computer with an internet connection by providing AIM Express, the ability to add buddies to your list without their approval, and is advantageous in that it needs less system space to operate. Nevertheless, the adding buddies without approval feature can be disadvantageous in that it creates poor security and system privacy controls. MSN includes peer-to-peer video conferencing capabilities, available versions in different languages, and better security. While you need to know a person’s screen name to find them on AIM, you only need to know their Hotmail email address to find them on MSN, which can make things easier.

Keeping the above in mind, we decided to encourage students to use the MSN service for instant messaging on class-related topics. This would require all students to sign up for a Hotmail account and to list their Hotmail address under their profile. Because MSN can also be used for video conferencing we thought it would be easier for the students to just use one service instead of two. Information concerning the installation and use of the MSN is provided in the Chat section of the website.

When considering video conferencing options we looked at MSN, NetMeeting, CUseeMee, and Click to Meet Express Conferencing. While both MSN and NetMeeting are free, both CUseeMee and Click to Meet Express Conferencing must be purchased. Going to the free software options we actually were only left with one service. Microsoft is the proprietor of both packages and is now promoting MSN for video conferencing, as opposed to NetMeeting. We are not sure, but there is the possibility that NetMeeting is getting phased out.

3.12.1 Real-Time/ Face-to-Face Communication

The only difference between the two packages is that while NetMeeting is a multipoint conferencing tool that allows the user to and share information with two or more meeting participants in real-time, MSN only allows point-to-point conferencing. Because our system needs a multipoint conferencing tool, we chose NetMeeting as our video conferencing package, but encourage students to use MSN if they wish to do one-on-one video conferencing since they are already using that package for instant messaging. If it is ever phased out we hope that Microsoft will incorporate multipoint conferencing capabilities into the MSN service.

Face-to-face communication adds greater depth to online interactions and allows the user to feel more invested in the conversation. Video conferencing is the means by which this face-to-face communication is provided. In order to participate in the video conferencing capability of this site, the user needs to have a web cam installed and connected to the computer. The Video Conference section of the site provides the user all the necessary information about how to attain a web cam, the different specifications and technologies available, and how to install. There are a wide variety of web cams available on the market, but for the purposes of this site, a very basic web cam will suffice for effective online video conferencing.
3.12 Discussion Forum

An effective collaborative environment possesses some means to support a running discussion so that participants may respond to others’ ideas and let their own ideas and opinions be heard. This discussion environment is instrumental in engaging people in a critical thought process and flushing out new ideas. Without it, important contributions to a critical discussion can be lost. All previous collaborative sites indicated the need to provide this functionality with the ability to allow participants to initiate discussion on a wide variety of topics themselves in order to effectively replicate the discussion that might ensue in a traditional classroom environment.

The message board was developed to provide a forum for users to hold a running discussion of pertinent course topics and online learning in general. In order to post a message the user simply enters in his or her name, the subject of the message, and the text he or she wishes to post. The user can either choose to reply to a previous message or start a new topic of conversation. This allows for any number of conversations of topics to be conducted at the same time in the same forum.

When we originally researched available bulletin boards both phpBB and Zorum were two candidates since they were compatible with our programming and database language. Because phpBB had more functionality, language options, and presented the opportunity to double as an instant messaging service, it was chosen over Zorum. Yet, after adding it to our website, we found that we were going to have great difficulty integrating it into our layout and transitioning from the website to the bulletin board and back again. We realized that we really needed a simple bulletin board and not one with lots of advanced features. After doing another search we found VenomBoard, a PHP, MYSQL bulletin board that appeared to be relatively simple code and would be easy for us to work with. After successful alteration and integration of VenomBoard into our website, we decided to keep it.

4 USABILITY TESTING

Usability testing is a technique for ensuring that the intended users of a system can carry out the intended tasks efficiently, effectively and satisfactorily. A website that is poorly designed, unattractive, unintuitive, and difficult to navigate, severely limits its effectiveness. The user interface is the means by which users access information and provide it to others. No matter how functional the website may be, if the interface does not allow for easy access and use of those functions, then it will be of little worth to the user. All attempts must be made to ensure that the interface is fully usable by anyone, regardless of their experience with computer interfaces. The design process should include a number of iterations of user interfaces, each representing an incremental improvement in ease of usability.

4.1 Testing

To effectively test any system, specific testing criteria must be determined to ensure that every aspect of that system is not only functional, but meets the user's needs. In order to run a successful usability testing, we came up with several characteristics that would affect usability of the website. They are listed below.

- **Latency**

  Latency is the amount of time it takes to process user requests. In general, latency should be minimized if at all possible.

- **Visibility**

  Visibility means knowing what the available options are. The website should be easy for users to figure out what to do. Also, the components of the website should be easy to read and distinguish.

- **Feedback**

  Feedback is telling the user the status of actions. For every action, there should be an obvious reaction. Feedback encourages users to track their progress and minimizes errors and confusion.

- **Mappings**

  Mappings are the relationship between controls and actions, and between display features and what they mean. Colors, textures, sounds, shape, size, symbols, and labels are all representational features that can be used to map information about the website.

- **Internal Consistency**

  Internal consistency means that the website keeps all operations and mappings the same or as similar as possible under different circumstance. This makes the website easy and convenient to learn and use.

- **Navigation**

  Navigation is a term used to describe all the actions required during product use. The website should be designed to minimize scrolling, if possible. For large systems, with multiple screens, organizing the layout and navigation of the screens is very important.

  By using above criteria, our group created a usability testing questionnaire. This questionnaire provides different sets of questions for each page of the website to achieve the maximum detailed feedback for each page.
The usability test was conducted by four students who are enrolled in Professor Garrick Louis’s graduate “Environmental Systems Analysis” course of the University of Virginia.

4.2 Results

Questions asked included:

- Does the page make a positive first impression?
- Are the labels easy to read?
- Is it easy to login / logout?
- Can you quickly move from page to page?

Additional Questions Asked for Comments:

- Do you think the site will benefit students?
- Do you think this site will facilitate communication between faculty and students?
- Would you recommend using this site?
- What do you think would make this site better?

All four students generally showed positive experiences navigating our website. They all said that the website was downloaded without difficulty, had good first impression and general appearance. However, three of four students said they could not see the additional links that we added onto our website. In addition, they said all the pages were easy to navigate through and they liked that the system provided immediate feedback for each action they take.

We could not collect much feedback on our Message Board page, and View Files page because all four students did not get an opportunity to explore these two pages. However, one of the students has tried using the View Files page, and agreed that the files were easy to find and view.

For the additional questions asked for students, one of the students suggested that we add more helpful sites related to the course “Environmental Systems Analysis”, such as EPA, UNEP, and World Bank. All of the students agreed that our website will benefit the students. They commented that the group capabilities of the website will be particularly useful for the distance communications. Finally, they all agreed that our website provides useful features for collaborative learning, and they would recommend using this website.

5 CONCLUSIONS

The immediate purpose of this project was the creation of a website designed to serve students from three universities: University of Virginia, University of West Indies, and Mapua Institute of Technology, participants in Environmental Systems Analysis, a course in community-based water resource management. The site was designed to facilitate collaborative learning among these students on the course material and on a collaborative water-resource management project. An additional goal of this project was to develop functional model for an online collaborative learning website, which could then be replicated for the formation of online communities with the intent of disseminating information to improve living conditions around the world.

The website possesses a number of features which allow students to communicate and collaborate. The major interactive features are a discussion forum to allow running discussions on relevant topics, file transfer capabilities to allow for the upload and download of pertinent documents to share and critique each others work, real time chat capabilities to hold instant online conversations, video conferencing capabilities to allow valuable face-to-face communication.

The technical specifications of the site were designed with students in less developed countries who possess limited resources in mind. Whenever possible, a free open-source option was chosen over a proprietary one. The site was designed with simplicity of use as one of the most important decision making factor. Not all students possess extensive experiences with online content. Simple and easy to use features ensure that student with limited technological experience do not become confused and discouraged, a factor which could significantly decrease the usefulness of the site.

5.1 Interpretations

Collaborative learning via the internet has proven in the past be a viable and successful means of reinforcing course material, as well as stimulating and building on the classroom learning. It brings students from different backgrounds together to share their diverse experiences with each other for the benefit of the entire group. People from different backgrounds have encountered problems and difficulties that others have not. If those students can be taught to understand those problems they may face in the future, the learning process can be greatly enhanced.

Currently it is not possible to determine the true usefulness of the site since it has not received extensive use from its intended users. Although the design and features of the site were based on recommendations from prior online collaborative learning experiments, and so far have proven useful and efficient, we are not able to determine whether this site will effectively promote online collaborative learning. As a result it can not be predicted whether this model will gain expanded use by other groups with the same purpose of creating online communities to disseminate valuable knowledge.

The website is designed in a way that makes it cheap to replicate and relatively inexpensive to implement and host in other locations. Its structure is simple and all the programming languages and technologies used are open-source option was chosen over a proprietary one.
source so that anyone may revise the code to suit the need of their specific learning circumstances. This feature of the site can greatly increase the pace of expansion to other groups of users. If the site were designed using proprietary programming languages and technologies, it would severely hinder its spread to other groups, especially those with limited resources.

There is a vast amount of information available in the world, but much of it is currently inaccessible to those who live in less developed countries. The internet is a relatively inexpensive means of accessing this information. It can bring information on an enormous range of topics to the user’s finger tips.

The information available on this website concerns the topic of community-based water resource management solutions. The majority of water resource management courses around the world approach the topic with the underlying assumption that a centralized approach is the best means to solve a given problem; however, this approach is expensive, and often does not take the needs and resources of the stakeholders into consideration. Therefore, this site is of special interest to those who live in third world countries, the user base that this site was ultimately designed to accommodate.

5.2 Recommendations

The design of this website was intended to serve as a prototype to provide experiences in the collaborative learning process as a means of determining the minimum requirements for effective online collaborative learning. Before any incremental improvements are made to the current design of the website, it must receive extensive use by users from a variety of backgrounds, countries, educational experiences, and online proficiency. Feedback needs to be gathered from these users concerning the usability of the interface, the usefulness of each feature, and the quality of the site as a whole. This feedback must be considered before any improvements are made.

There are a number of features which could be added to further enhance the learning process; these must be investigated and evaluated. It may very well be the case that these features do improve the overall collaborative learning experience, but special care must be taken to be sure to recognize whether these features affect the key intended users of this site: users from less developed countries. Most cutting edge educational technologies come with a steep price tag, which make them out of reach for users with limited resources. In addition, new technologies, while they do provide great benefits, are often complex and difficult to use, contradicting one of the stated goal of the website: simplicity of use.

Even if the site is utilized by participants in several different classes around the world, there is no guarantee that the site will be fully utilized unless steps are taken to formally familiarize the users with the site and its features. Tutorials and interactive exercises need to be created in order to acquaint the users with each of the different features of the site. Different users have unique technological learning curves so these tutorials need to begin with the most basic technological concepts before explaining the features of the site in depth. Strategies can be developed to further engage the users. For instance, a mandatory weekly discussion held at a prearranged time can be a simple means to bring users together and force them to interact.

This website can serve as a useful learning tool, but its true effectiveness at enhancing the learning experience can not be accurately determined without an objective study measuring all variables which affect learning. A study of several groups of users with different backgrounds and technological proficiencies should be performed over a significant period of time in order to gauge the effectiveness of this site in specific, and the online collaborative learning process in general.

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