New E-learning 3.0 platform proposal and evaluation

Yifei Liang
The University of Queensland,
Australia

Tian Liang
The University of Queensland,
Australia

Pedro Isaias
The University of Queensland,
Australia

This research will explore how to improve the current University of Queensland (UQ) "BlackBoard" system, so that it fulfills the E-learning 3.0 requirements. Therefore, after adapting literature review methodology, a new E-learning platform will be designed and built, and it will be tested by the focus group for further development. Functions such as video and text chatting, file sharing and others, will be initially implemented to ensure it is an E-learning platform. The research will then be able to realize functions, such as recommendations of relevant learning materials, by using Web 3.0 technology, in particular the basic semantic analysis. The whole research aims to increase learning efficiency and provide students with a better learning experience. The research is co-operated by two researchers. Although sharing a mutual goal, the researchers will each have a separate focus. One will focus on developing text chatting, file sharing, records checking, relevant materials recommendation functions and other contents like user interfaces, while the other will focus on developing video chatting, room creation, login, and relevant functions as identified and recommended by tutors. On completion of these processes, the identified key improvements and modifications will be applied.

Keywords: Web 3.0; E-learning 3.0; Semantic Web; Learning efficiency

Introduction

With the development of Web technology, the E-learning platform has seen significant improvements. Nowadays, the E-learning platform can get artificial intelligence and relevant technologies involved (Sofiadin, 2014), so that it can assist students achieve a better understanding of knowledge. Therefore, this research decided to utilise various new technologies, such as basic semantic analysis, to enhance student learning efficiency.

Today, many lecturers at UQ prefer to use applications, such as slack or piazza to help them complete various study activities. However, some important functions like assignments submission are all based on the UQ "BlackBoard" system. It is inconvenient for students to keep switching between those applications and Blackboard. Also, there are many students who are living a significant distance from the university, and it is challenging to physically attend all the lectures and tutorials. The system could provide an alternative option for students who are unable to attend some of their classes. Based on these reasons, a new E-learning platform prototype is designed and built, which aims to combine with the UQ "BlackBoard" system and providing some functions to increase students' learning efficiency.

In this research, functions such as video and text chatting, and automatic recommendation will be implemented. In addition, the main technologies that would be used are Java Spring MVC framework, WebSocket, WebRTC and basic semantic analysis. All of these will be introduced in details later.

Literature review

In this part, the history of Web and E-learning are introduced, including the definitions, and relationships between the Web technologies and E-learning. Then, it will introduce how the idea of this research arose and what this research tries to implement.

Web & E-learning development:

Web1.0 & E-learning1.0:
In the past several years, the World Wide Web developed rapidly and has become entrenched as an essential part of modern life. An increasing number of users rely heavily on this global information media. At the first stage, the Web1.0 does not have many functions.

Figure 1: Features of Web1.0 (Nath et al, 2014)

Figure 1 depicts that the Web1.0 as a one-way system from the producers to the consumers. The websites in Web1.0 just include the contents provided by producers. That means this kind of web just allows users to read directly without any other interactions. In this situation, teaching and learning has begun with the aid of computers, which is the start of E-learning 1.0 (Ebner, 2007). In the E-learning 1.0, teachers deliver materials about knowledge to students via learning system (Ebner, 2007). The static learning system becomes the bridge between the teachers and learners.

Web2.0 & E-learning2.0:
The Web 2.0, as the next generation of networking service with more ways for communications, supports not only reading but also writing, modification and so on (Nath et al, 2014). Unlike Web1.0, Web2.0 enables websites to be able to interact more with users and process the data entered from users and sometimes yield results, as figure 2 shows.


Figure 2: Features of Web2.0 service (Nath et al, 2014)

In this stage, E-learning is evolving with the development of the World Wide Web and it becomes E-learning 2.0 which becomes more socialized. The teachers arrange the consultations, quizzes, and notifications, with the aid of the learning system, to their students (Downes, 2005). Also, students can share learning materials and learn together (Downes, 2005). As mentioned, chatting applications, including the UQ discussion board, facilitate student discussions and promote educational opportunities for sharing ideas and materials. This meets most features of E-learning 2.0 to some extent.

Web3.0 & E-learning3.0:
After both technology evolution and social evolution, the Web is moving into a new generation: Web 3.0. Figure 3 shows that, in the Web 3.0 phase, the machines are used more in the process of interaction between users and producers. As a result, the Web 3.0 is expected to demonstrate vast improvements from Web 2.0, such as the satisfaction of customers, data integration and reuse for getting new results and improving collaboration in the social web (Evans, 2007). On the other hand, until now, it is still difficult for different experts to give an exact definition of this new conception, but from the IT perspective, the semantic analysis and personalization are considered to be the main parts of the future web (Nath et al, 2014).
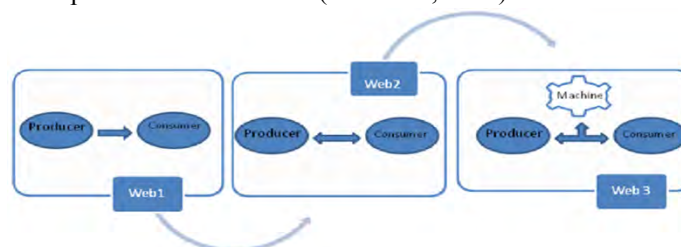
Figure 3: Web3.0 evolved from Web2.0 (Pattal et al, 2009)

The idea of the semantic web is first pointed out by Tim Berners-Lee who is the creator of the World Wide Web and foresaw the probability of machines understanding the meanings of semantic data (Barassi and Treré, 2012). In the current stage, the evolving of new technologies, such as smart mobile, big data, and AI makes the prediction of Web 3.0 be able to be realized. Then, another important feature of Web 3.0 from IT aspect is personalization. To some extent, the semantic analysis also aims to understand what users are thinking better so that the websites can provide more efficient and personal services for people in need.

At the same time, E-learning starts evolving to its next generation. Based on the available technologies of Web 3.0, the E-learning 3.0 is also expected to improve learners' ways of study and learning environment. To be specific, the E-learning 3.0 will be combined with smart mobile technology making it possible for learners to study anytime and anywhere (Rubens et al, 2012)

The prototype:

In this research, a platform is designed to improve the discussion board in the UQ system. After all, the Web 3.0 technology can indeed bring many benefits to the E-learning platform, including enhancing the personalized studying environment and managing learning information effectively (Miranda et al, 2016). The platform has two parts: building a basic E-learning 2.0 platform, and updating this platform to E-learning 3.0. The functions, such as video & text chatting and file sharing, will be implemented in the first part. These functions belong to E-learning 2.0, as they focus on the interactions and management of the educational information (Giannakos and Lapatas, 2010). The second part is to develop some personalized functions. There are various technologies included in the E-learning 3.0 area, as figure 4 shows (Dominic and Pilomenraj, 2014). Many directions can be developed in the E-learning 3.0 platform, and they all have their own advantages to students and instructors. For example, the 3D visualization could give students a better understanding of the molecular structure.

Figure 4: Technologies in E-learning 3.0 (Dominic and Pilomenraj, 2014)

In this research, the Web 3.0 technology that will be used is basic semantic analysis which is one of the core techniques in the Semantic Web area. The Semantic Web can be very helpful for assisting instructors from many aspects, including course developing, record storing and learning materials controlling (Morris, 2011). With the help of semantic analysis, the platform delivers convenience and benefits to the students.

Functions

In this research, the functions that have been developed are: login & creating rooms; Multiplayer video chatting service & Tutor video chatting service; Relevant tutors recommendation; Text chatting & File sharing & Chatting records viewing; Relevant materials recommendation.

Login & Creating rooms:

Login function is the basic function for validated students or tutors to enter this platform. Creating rooms is one of the main functions of this platform. The create room button is on the home page after successfully login as figure 5 shows.
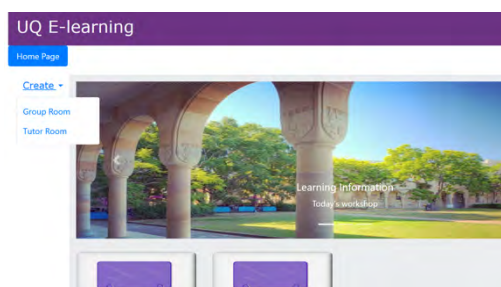
Figure 5: Create button on the left side of home page

When a student clicks the button of creating a group room, the form on the left of figure 6 will pop up. Also, when a tutor wants to create a tutor room, the form on the right of figure 6 will be pop-up.
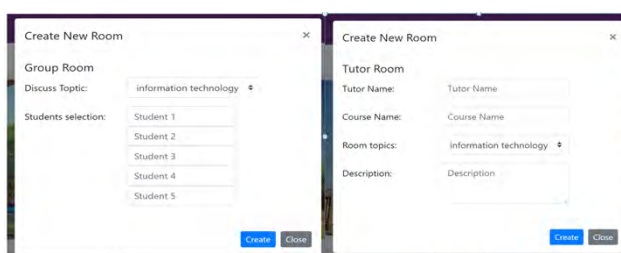

Figure 6: Pop up form for creating group room (left) and tutor room (right)

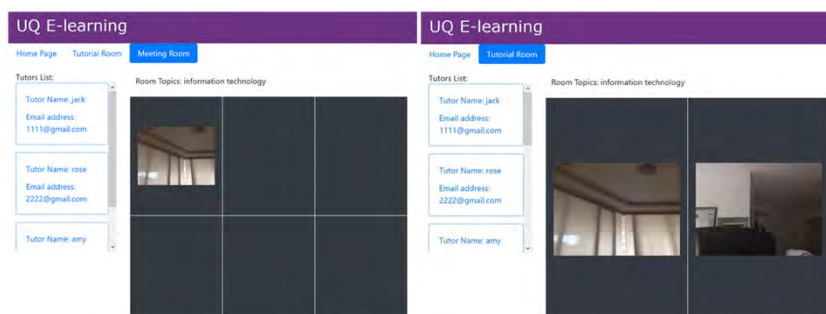**Multiplayer video chatting service & Tutor video chatting service:**

Figure 7: Study group room interface (left) and tutor room interface (right)

- In the study group room, there are up to six students allowed to have an online face-to-face meeting together. They can discuss the questions for the group assignments anytime and anywhere. The interface on the left side of figure 7 shows how the study group room looks like in this prototype.
- The tutor video chatting just allows one student and one tutor in each tutor room. Therefore, the tutor room is actually a one-to-one individual consultation or teaching room. The whole user interface of tutor room is shown in the right interface of figure 7.
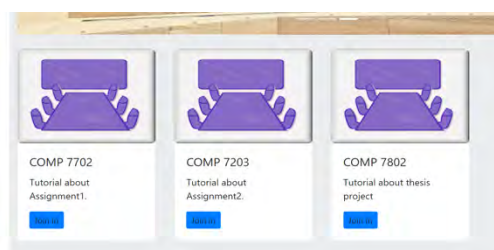

Figure 8: New tutor room showed in the home page

After the tutor created the tutor room, the home page will refresh and it will look like figure 8 (compare to with figure 5). Figure 8 shows the third new tutor room is updated on the home page when a tutor has created a room successfully. If students want to join in the room, they can just click the join button, and tutors also can choose to accept or reject these participation requests.

Recommendation for relevant tutors' e-mails:

This function uses the technology of basic semantic analysis. The system can gather the room topic, and the majors of room members, and search for the relevant tutors' data from the database. Finally, tutors' e-mails will be shown dynamically on the left layer of each room like figure 9 shows.
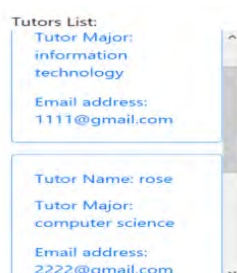

Figure 9: Relevant tutor recommendation

In that case, if students have any questions, they can send an e-mail to other relevant tutors during the online discussion or consultation. For example, if a group of Computer Science students are discussing some programs of Information Technology which is their room topic, and some questions arose. According to room topic and their majors, the room will recommend some tutors working in IT or Computer Science so that these students can find the relevant tutors' e-mails in need quickly without wasting too much time for searching these tutors on the UQ Blackboard.

### Text chatting & chatting records viewing:

This function aims to provide a text chatting service to students in the same room. A notification will appear when someone joins in the room. During text chatting, as the figure 10 displays, the sending time and name of the student who sent the message will also be displayed. Furthermore, if the sender is the user, the user icon will be shown at the right, otherwise, it will be shown at the left, which aims to help students distinguish their sentences more easily.
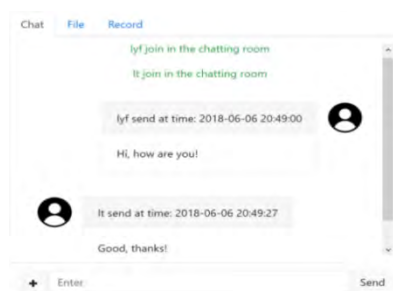
Figure 10: Text chatting situation

Some students may be late to join in the room, and they have already missed plenty of things when they join in the discussion. In that case, the chatting records viewing function is provided. Students can switch to the record tab and click the "Records" button to check all the chatting records.

File sharing:
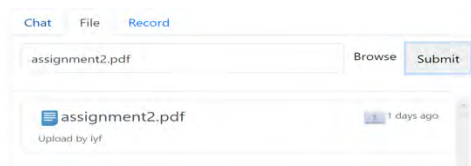
Figure 11: File sharing interface

This function provides a file sharing area for students in the same room to share documents. Each uploaded file will generate a hyperlink for downloading and displaying some detailed information, including who uploaded the files and so on. These files can only be accessed by the students in the same room. Figure 11 shows the situation when the file named "assignment 2" uploaded.

Relevant materials recommendation:

To reach the E-learning 3.0 requirement, the recommendation function is designed and it is automatic and dynamic. It will analyze the room topic and each discussing sentence. After filtering, the server will retrieve relevant materials and display them. Figure 12 shows that the system recommends one more book after entering the sentence which contains meaningful word "software". Besides, all the materials information is forged and these materials are all use "Book X, link: XXXX" to represent.
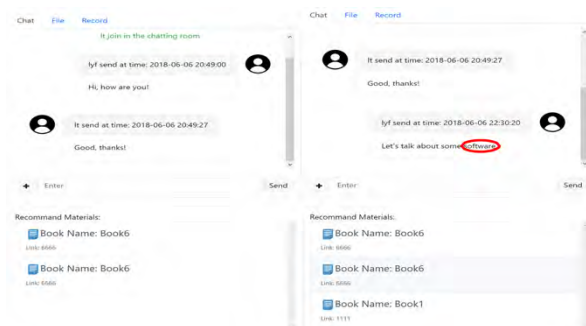
Figure 12: Comparison of materials recommendation situation after entering "software"

Technologies

The main utilized technologies are SSM framework, WebSocket, WebRTC and basic semantic analysis, which will be introduced separately. However, other utilized technologies will not be discussed in detail, such as JavaScript, JSON, Bootstrap, MySQL, JSP and others, as they are more familiar.

HTML5 & Java Web SSM framework (Spring + Spring MVC + Mybatis):

- The platform uses HTML5 technology because it makes user interfaces support multimedia, such as video and audio elements are added into the HTML5 (Pfeiffer, 2011), which make it possible to realize the design of multiplayer video chatting in this research.
- SSM is a popular framework for Java web programme development. It is based on the Spring framework in Java and combined with Spring MVC extension and Mybatis technology. Mybatis is used to connect to the database, to realize the data transmission between server and database.

WebSocket & WebRTC:

- WebSocket is a core technology to implement all the functions, such as video & text chatting, relevant materials and tutors' recommendation in this research. WebSocket is a single-socket connection which has the features of full-duplex and bi-directional, and it can help developers to build real-time web applications (Pimentel and Nickerson, 2012). One of the advantages is that WebSocket is able to push messages to the users actively without waiting for users' actions.

- WebRTC is one of the most important technologies in the platform. It provides the specific functions of peer-to-peer connection without distributing by the server, building a solid foundation for realizing the peers' video chatting. With the evolving of the multimedia, WebRTC mainly focuses on solving the problems of real-time and video-based communications in the browsers, which meets the requirements of the major ideas of this research. Besides, WebRTC is an updated technology that supports high-quality video and audio in the browsers without installing applications or plugins (Ristic, 2015). Until now, many browsers have already supported this technology, such as Firefox, Chrome and Edge.

Basic semantic analysis:

In this E-learning3.0 platform, semantic technology is used in a basic way in keywords filtering for finding out the matched tutors' majors and material's tags from the database, to retrieve relevant learning materials and tutors.

Results and discussion

Results:

Prototype design:
1. The core functions are all implemented successfully, and all the works have been integrated.
2. There are still some detailed problems and many suggested improvements have yet to be made. For example, some security problems of peer connections.

Focus group:
There are 6 students in the focus group, and they were invited to have a face-to-face meeting for testing this platform. Then the developers need to facilitate discussions and collect feedback based on a pre-designed question list answered by the focus group. There are 5 questions in the list, and they are designed to help the focus group identify and organize their suggestions. For example, some questions aim to check whether the platform can indeed help them, while some questions seek suggestions from the users perspective on what can be improved. As stated in the ethics application, all feedback and results collected will be anonymous

Discussion:

As mentioned, all the functions have some improvement spaces, and the suggestions from participants have been invaluable. Figure 13 shows the percentage of students' opinion of each question. In general, the results indicate that this platform is good.

Figure 13: Marks for all the questions

Suggested improvements and some solutions are all shown below:

Creating rooms:
- When students try to join in the room, they should be notified of what position they hold in the queue or how long they will wait. If the time is too long, students have the option of completing alternative learning activities, which saves time and increases efficiency.
- To add convenience for finding rooms, the area for displaying available rooms should have page turning function. Setting a search filter may be a good choice, but should not exist with the searching function at the same time.

Tutor video chat service & Multiplayer video chatting service:
- Students can choose whether they want to open the video or not. For example, some students may decide that they are not in appropriate place to stream video (such as in bed) so they require an option to close the video while still using the audio function. This ensures students' privacy.
- During the video chatting, especially in the tutor room, the students' side should have a button for asking questions, otherwise, tutors may keep talking and until students types their questions through text chatting service, which is considered inconvenient.
- The join in approval should be removed because if many students keep clicking the join in button, this tutor room will be interrupted continuously, which is considered disruptive and annoying.

Recommendation for tutors' e-mails & Materials & Chatting records viewing & File sharing:
- Recommendation function needs to be improved and one tester even thinks it is unnecessary. Her reasoning is that there is no need to recommend the tutor's information in the tutor room, as the tutor is just there. Also, in most cases, the problem discussing happens among the students who are enrolled in the same course and potentially also in the same major, so they presumably know all the tutors' information already. After discussing, the solution may be: recommend other teaching staffs like lecturers and the staffs in the student center, and the recommendation will be improved based on more information, not only the room topic and majors.
- The focus group thinks the materials range need to be inclusive of large resources such as google scholar. Additionally, users can look into these materials with the UQ authority so they do not need to log in again.
- The platform should reconsider the authority limitation because they think the same students who enter the same room have the right to check the previous records while others cannot.
- One of the members thinks the platform should have a cloud server involved so that all the files can be uploaded to there and students can access that cloud server even if the room is closed.

Other improvements:
- The tutor rooms can add another online tutorial room which only provides one video from the tutor, and the maximum numbers of this kind of room could be 20 or more.
- The data visualization could be involved. By analysing the text messages, the server can provide a report or diagram which may identify and illustrate information such as what kind of problems are identified most frequently. This function can bring benefits to the tutors and lecturers.
- The collaborative notes taking function may also be a good idea, which allows students to create one note together and generate a copy and send to everyone when the room is closed.
- The focus group suggests the functions like first time using navigation, translation, and online-list could be implemented, too.

Conclusion

This paper introduced how the Web technologies and E-learning develop, and illustrates the implementation direction of this research. The prototype which the research mainly focuses on, aims to increase convenience for the students and to improve the study efficiency. An E-learning 3.0 platform has been built and all the functions are realized, including text and video chatting, room creating, login, file sharing, chatting records view and relevant learning materials and tutors' recommendations. The members of the focus group unanimously agree with that this platform can greatly assist students to complete educational requirements and learning activities with greater ease and efficiency. However, as mentioned, this platform is just a prototype. There are still several focus group suggestions yet to be realized and implemented to allow this platform to reach its full potential.

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