# Web Interactive Multimedia Technology: State of the Art

Asma Md Ali and Joan Richardson

School of Business Information Technology and Logistics,
RMIT University, VIC 3001, Melbourne
{Asma.mdali,Joan.richardson}@rmit.edu.au

**Abstract.** Elluminate a web interactive multimedia technology (WIMT), which is an information and communication system, was introduced in a large metropolitan University. Its attributes are outlined in this paper, from just text-based to more complex-based features. The system incorporates several multimedia features, such as chat, audio, video, polling, whiteboard and desktop sharing. This system provides real time collaboration. When used in a university teaching and learning environment, it enables immediate feedback between participants across physical space. This gives an added opportunity for interactivity in an online learning environment. Relationship building capacity between academic and student is a vital component of learning. WIMT enables augment learning through interaction between academic and student.

**Keywords:** Web interactive multimedia technology, Blended environment.

## 1 Introduction

This short paper introduces web interactive multimedia technology (WIMT), an information and communication system used by the university. Information and communication technology (ICT) continues to shape public and professional interactions. With the emergence of the internet and web technology, information is ready-made and data easily accessible. Hence, accessing and disseminating information becomes even easier to users but challenging for developers in the web development lifecycle. The Internet-based World Wide Web has had an enormous impact on web applications and society due to features that provide a means for collaborative learning, open access to information and social networking.

Universities began to adopt blended learning approaches to teaching which enriched the learning experience for all students irrespective of age and nurtured life-long learning. Blended learning incorporates learners' interactions with lecturers, online learning via interactive multimedia systems and self-study.

This research is in progress at a large metropolitan university with several campuses in Southeast Asia that have trialed Elluminate. University wide implementation is planned.

The next section will explain the research motivation in looking at the extended opportunity for interactivity in an online environment using web technology.

## 2  Motivation

Web technology has been receiving the attention of IT professionals since the development of the internet. It is similar to other human made technologies such as the telephone and television in that it is a tool used to disseminate information. Humans are then responsible for evaluating and comprehending the message and ascertaining its usefulness in their own particular context. Users are demanding improvements in computer based message delivery environments, modes of delivery and message composition. Designers need to keep pace with continuously changing available technologies. The stakeholders involved include: builders, designers, content developers, web maintenance roles and the user (in specific purpose and context).

Although there is no single definition for the term 'web technology', there are well-known characteristics of the web that researchers and practitioners agree need to be considered to design, develop, and implement web delivery systems in the higher education context. These characteristics include: ubiquity, existence of open standards, interlinking, easy access to information and services and easy content creation [1], [2].

The web can be categorized into fixed and/or mobile access systems according to the devices and applications used. The fixed web is where the end-user utilises wired devices like a desktop to access the internet whilst the mobile web is where the end-user utilises mobile devices to access the internet, such as iPods, notebooks and mobile phones. Wireless devices are beginning to be implemented in universities to facilitate a collaborative learning environment [3]. This study focuses on the fixed web, specifically desktops and does not include the mobile web area.

Web technologies such as Active Server Pages (ASP), JavaScript, VisualBasic Script, Structural Query Language (SQL), Open Database Connectivity (ODBC), AJAX and streaming video technology have pushed the dynamic experience of users. Web interactive multimedia programs are being used in various fields such as business, education, training and health care. With the recent advances in artificial intelligence, knowledge representation and technologies for information systems, there are various methodologies being used in modeling and developing interactive multimedia programs [4].

However, there are few research studies being done on the deployment of systems which look at best practice. The study reported here examines case studies of effective use of WIMT particularly for university learning and teaching. It is posited that the use of interactive multimedia programs can provide a richer teaching and learning environment and enable collaborative work using the web element that would otherwise not be possible. Baharun and Porter [5], Boulay, et al., [6], Craig, et al., [7], and Cody [8] describe cases where a website has augmented the teaching of statistics; online material has been developed to teach molecular biology; web based lecture technologies have been used to teach medical students and an online database has augmented the teaching of dance.

Iivari, Isomaki and Pekkola [9] mentioned that there are signs of the Information Systems (IS) research community broadening its focus to include investigation of user-oriented design of multi-media systems and research methods. There are calls for
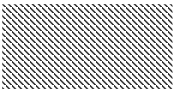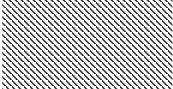
researchers to enter the web and blended learning research community [10]. According to Ivory and Megraw [4], the pattern for web research started with a back-end approach (the database and infrastructure) and then shifted towards a front-end approach (interface and users). The focus towards user-oriented methods is emerging in the IS research community [9]. Furthermore, there is a need to do this research as the quality, extent and impact on learning of ICT use in blended and online learning environments remains an under-researched area [11].

In Australia, an exploratory study on the impact of web technologies on learning in universities has commenced [12]. One large metropolitan university has completed a pilot study and is currently carrying out a university wide implementation. This is where the case study described in this paper is being conducted. Among the web technologies being researched are web-based lecture technologies (WBLT) and Web3D. There are published resources and opportunities for the researcher to develop skills and knowledge in various types of web technologies focusing on collaboration and interactivity such as Elluminate which has been adopted by some schools and universities in Australia.

## 3 Glossary of Terms

Some of the terms used in this paper are defined as in Table 1.

**Table 1.** The glossary of terms used in this paper

| Term | Acronym | Definition |
|---|---|---|
| Blended environment | | Mixed web and face-to-face interaction in a traditional classroom. |
| Elluminate | eLive | A web interactive multimedia technology artifact. |
| Information Systems | IS | A field of study that incorporate technology, societies and organizations. |
| Interactive | | Non-static; response to user input. |
| Multimedia | | Combination of two or more: audio, text, image, animation and video. |
| Web Interactive Multimedia Technology | WIM Technology; WIMT | Systems that combine more than two media, respond to user input and delivered/accessed through the internet. |
| Web Technology | | System access through desktop from the internet infrastructure. |

## 4   State of the Art

Universities provide web delivery of learning and teaching resources, specifically targeted at adults who need to take care of their families, manage their career and pursue a higher education. One of the key deliverables of web learning is web interactive multimedia systems that facilitate the learning and teaching process.

### 4.1   Blended Environment

One approach in using web technology for learning in universities is a blended environment. It is a mix of web and face-to-face interaction in a traditional classroom or lab or physical space. Positive findings using blended learning include indicating learning quality in an online community using an interaction based approach [14].

Eklund, Kay and Lynch [15] state that the growing trend towards blended learning environments recognizes that the use of ICT augments face-to-face delivery, and provides unique experiences that assist in achieving desired learning goals. Blended learning allows for learning and teaching practices to be combined into a custom made learning experience for each individual learner [15]. Blended learning has been successful because it commonly emerges as a delivery technique from a process of planning and analysis. There is also evidence to show that it is a learning design implicit in many success models. According to Zhang et al., [16] the environment places emphasis on learner-centre activity and system interactivity that can enable distance learners to outperform traditional classroom students. Therefore, blended environments have the potential to improve traditional classroom learning [16].

### 4.2   Text-Based

Collaborative activities where students can use e-mail, forums, bulletin boards and share and edit documents online arise as alternatives to the more rigid Learner Management Systems, like WebCT. The collaboration with students renews the teacher/learner relationship whilst maintaining immediacy and minimizing the need for technical expertise. Inter-person collaboration and knowledge building is seen as one of the most effective way for adults to learn. The future of lifelong learning depends on reducing the gap between the conceptual arguments and real effective implementations of WBLT.

### 4.3   Audio-Based

There is also evidence that web-based lecture technology (WBLT) is used by students as a study tool to complement face-to-face lectures [12]. Students report using WBLT to support their learning by checking over notes, reviewing difficult concepts, preparing for exams and listening to missed lectures. The acceptance of this delivery for private lecture study has been overwhelmingly positive and shifts towards being a successfully embedded technology.

Further questions of how WBLT's can be integrated into the delivery of a unit of study by adjusting the lecturing style and how a course can be delivered to make the most effective use of web-based lectures are yet to be answered [12]. The feedback

from staff and students in Gosper's [12] study also raised questions relating to changes in teaching style, good teaching practice, perspectives on the use of WBLT, the best way to support learning, different uses to support learning (rather than delivery), differences across disciplines and modes of delivery, as well as other ways to enhance learning, teaching and curriculum design. Gosper's [12] study also confirms student's appreciation of the convenience and flexibility offered by time and access to lectures.

## 4.4   Video-Based

With increased demands posed by work and family commitments, one way to address students need for flexibility is to provide easy access to lecture recordings. In addition to flexibility, the impact of these technologies is generally positive on students' learning [17]. McElroy and Blount's [18] surveyed 411 students who had used iLecture technology.  More than 75% of students agreed that iLecture enhanced the course when compared to other subjects that did not utilise the technology [18]. Soong, Chan and Cheers [19] reported on a similar study conducted in Singapore, where video-recorded lectures had been created to support students' learning from traditional face-to-face lectures. In a survey of 1160 students, they found that 94.9% agreed that the video-recorded lectures were useful in relation to their studies. The most popular reasons for using video recorded lectures were for reviewing difficult parts of the lectures and for exam preparation [19].

## 4.5   Audio-Video-Based

Web-based Lecture Technologies (WBLT) have been studied by four universities in Australia namely Macquarie University, Murdoch University, Flinders University and The University of Newcastle. Lectopia, was the WBLT, researched as it has the capacity to integrate the Learning Management System (LMS), Blackboard and WebCT.  Research on audio recording technology and linear video technology of live lectures was conducted using a case study approach comprised of a mixed method: survey, questionnaire and interview [12]. This study would like to look at Web Interactive Multimedia Technology that has more features than linear audio and video technology.

   In Gosper's [12] report examining cases where WBLT had been used by the students and staff, 76% of students and 54% of staff rated the  experience positively. However, there was inconsistency between between student and staff perceptions of the benefits of WBLT for learning (80% students compared with 49% of staff agreed) and achievement of better results (67% students compared with 30% staff agreed) [12].  An exploration of the impact of WBLT on learning and teaching is of interest to the higher education sector. This is because of the increasing demand from students for flexible access to educational opportunities, and substantial investments by institutions in this area. Relationship building between academics and students is a vital component of learning.  The potential to substantially improve teaching practice, to improve the students learning experience and to contribute to the development of effective mechanisms for the identification, development, dissemination and embedding of individual and institutional 'good practice' in universities are exist.

## 4.6  Complex-Based WIMT

It is useful to evaluate these systems to obtain a better understanding of the effectiveness of multimedia programs. The complex-based WIMT incorporate the five multimedia elements, which are text, audio, video, graphic and animation. Elluminate, a web-based conferencing software application for real time collaboration, provides opportunities to conduct tele-tutorials in a virtual classroom setting.  Elluminate has been used as the case study described in this paper. It enables instructors and users to have real-time discussions while viewing PowerPoint slides, web sites, whiteboard and shared applications - all of which are interactive. It also offers text messaging capabilities, ad-hoc surveys (polling) and basic assessments. Classes can be recorded for later playback.

This research looks at how Elluminate functionality and features have been integrated into the teaching and learning activities.  What have been the pragmatic learning and teaching activity design and technical issues? What features have been used?  What has been the impact of the new technology on learning and teaching resources and delivery modes?

## 5  The Problems

The university IT services decided to do a pilot study in order to implement a complex-based web interactive multimedia technology in the university. However, the technological infrastructure has delayed the committee to make decision on implementing it. Another problem is lack of staff training during pilot as only volunteers are called to participate. Surprisingly there exist staff that use the technology without involving themselves in the pilot study.

## 6  The Method

A qualitative method was used to enable the researcher to answer the research question: How did the university implemented web interactive multimedia technology (WIMT)? Furthermore, this study will be driven by the interpretive paradigm as this research attempts to understand a phenomenon through accessing the meanings that participants assign to them [20]. This research adopts the case study research method as this is an exploratory study and the researcher needs to obtain in-depth data on WIMT implementation in the university environment. The case study was conducted at a large metropolitan university that has conducted a pilot study of Elluminate use and is currently implementing the application. A key person from the pilot project committee, and a coordinator of a graduate program were interviewed using a semi-structured interview approach. This enabled two points of view to be collected, from the administration implementer and the academic user that used the technology to complete work tasks. Ethics approval was obtained to record the interviews and use transcripts and written notes for this research. The one-on-one interview took approximately 30-40 minutes. The implementer commented on issues related to the WIMT implementation in the large metropolitan university followed by the user perspectives.

The next section will explain the case study in looking at the extended opportunity for interactivity in an online environment when a web interactive multimedia technology is implemented in a university.

# 7  The Case Study

Universities and colleges present a unique setting to explore the deployment of new technologies. Some universities purport that teaching is one of the top priorities, with research and service playing important roles. However, teaching with WIMT can require more time and effort to prepare quality learning and teaching resources. University faculty members tend to have some control over what content is taught, and more control over how the content is taught and assessed [13].

Learning via the Internet, intranets and extranets is increasingly understood to be a subset of e-learning (technology supported learning). Web-based learning is an identifiable artifact of learning objectives, content and interactions. There are efforts to determine the factors that create successful web-based learning programs which include establishing a basic framework covering dimensions as diverse as the pedagogical; technological; interface design; evaluation; management; resource support; and ethical considerations. There also exist discussions of cognitivism and constructivism in learning that focus on achieving higher level learning in independent, self-reliant learners who can imply a range of strategies to construct their own knowledge.

Web based learning is seen as a means to modify or influence the behavior of clients and hence to achieve corporate goals within market. The corporate sector's recognizes the benefits of e-learning and extends these beyond their investment in their employees. For example, Melbourne water developed a website to educate children on water conservation, believing that educating users online will help increase waste-water recycling to 20 per cent by 2010.

# 8  The Findings

## 8.1  Case Study 1: Piloting Elluminate in a University - Academic Developer

Elluminate was piloted and implemented in the university after three types of software had been evaluated. Initially there were some technical issues for end-users of Elluminate caused by the ICT infrastructure. However, as the software and infrastructure have matured, the university has decided to implement Elluminate to practically realize and reap the benefits of WIMT:

> "The university have been waiting for a software and the technology (including bandwidth, reliability of the technical aspect) to come closer together to make it possible for the idea of all things you can do in Elluminate being useful for people. You can use it for distance learning, tutorial, professional development and software training".

This includes making use of the complex-based WIMT features, which are messaging, audio and video conferencing, audience response tools, whiteboard and

application   sharing. A pilot study was conducted to test the technical capacity of the WIMT rather than the actual learning and teaching aspects, the core activity of a university: "The pilot study look more at the technical side of things. It should have also addressed the learning and teaching aspect".

As the pilot committee was satisfied with the pilot study, Elluminate was to be implemented to university wide. This involved three faculties. So the next step was to create a "good communication strategy" to support the implementation. To support uptake of the recommended WIMT, successful examples of WIMT implemented in learning and teaching activities including "how they were used and what benefits were obtained from using it" were published and demonstrated for others to see the practicality and benefits. The published examples were intended to support staff in extending their learning beyond the traditional boundaries.

## 8.2   Case Study 2: Exploring Elluminate in a University - Academic Lecturer

During the pilot study, academics were asked to volunteer. However, the user interviewed was not directly involved in trialling the technology in the pilot study. She came across Elluminate when she was setting up a graduate neurology course for distance education students. The university informed her that the previous virtual learning environment system was no longer available and the university was currently adopting and piloting Elluminate: "I needed to have a virtual classroom connected (for my distance education students) and they said we are using Elluminate now." She straight away installed Elluminate and found it was user friendly and easy to use. She did not go to the formal university training sessions but she managed to explore it on her own: "Although I missed out on the (formal) training, it was quite intuitive (to use it)". When a certain task to accomplish a planned activity was a bit of a challenge, she contacted the university Elluminate support team in the teaching and learning unit and joined a network of users involved in the pilot who were exploring the features and functionality of Elluminate in real time. The previous virtual learning environment was just text-based. The lecturer and students had to communicate using the written word without any sound or pictures and images to discuss and present: "Elluminate is light years ahead because the virtual learning environment (the previous software) was only text-based".

There are more than just text-based interactions in Elluminate as graphics can be shared which is important to learning. In the graduate course, the students have only a 2-hour session each week and they have to do a lot of self study in their own time. The Elluminate session time is used to update, discuss, raise any issues that they do not understand or require additional clarification from the lecturer: "I use a lot of graphics to overview the course content to make sure the students have not got any queries and that they are happy with the week learning that they have to do." This is crucial in a neurology course that looks at neurological processes through different scanning mechanism using CT scan and IMR: "…looking at different neurological processes through different scanning mechanisms is very crucial". The discussion on the neurological processes was made clearer by showing actual CT scanned images and IMR graphics: "…able to do that in Elluminate by uploading CTS, IMR and those sort of things are very helpful".

Elluminate also enables audio conferencing and up to six simultaneous speakers. In the neurology course, the lecturer allowed the maximum number of audio and video participants:

"I had maximum simultaneous talkers and maximum visual. I had all the pictures (video) of the students every week".

However, if the students have audio problem, they could easily use the textbox feature that is also available in Elluminate to ask questions and provide feedback in discussion: "Some of the students have problems with sound and things so we use textbox".

Elluminate also has several whiteboard interaction tools including a pointer and a highlighter for the virtual whiteboard. Items can be circled or coloured: "I use a pointer to actually point to different things as I go through because as I was going through a CT scan for example or a scanned picture, I use a pointer to point at the hotspot or the area that was significant".

## 8.3 Technological Opportunities and Challenges

As with other technology implementation, there are pros and cons, the obstacles that had to go through before getting to launch it, the silver lining behind grey clouds. In Elluminate, the students that participate in a real time session drop out and in again: "people/computer dropping out". In the neurology course case, the coordinator ran into a major problem in the initial stages. She was not able to login into the system. When she called Information Technology Support (ITS) staff, the support staff took a long time to solve the problem as he was not a participant of the pilot study and had no idea about Elluminate: "Initially I run into major problems in the beginning of the semester…the first call to ITS they had no more idea about Elluminate than I did (because they were not informed or included in the pilot study)". The ITS staff and support staff from the teaching and learning unit were very helpful in trying to solve the problems and obstacles faced by the graduate course coordinator: "…(support) people have been very supportive". She managed to get Elluminate running and has been using it ever since:

"The ability to talk is an advantage because virtual classroom (previous software), you could not talk, you could only text with typos and quick typing".

With Elluminate, a complex-based web interactive multimedia technology, she could talk, interact with the students on the whiteboard: "I have them draw on the whiteboard" and "we do discussion verbally through microphone".

She had already prepared the materials for the on-campus students that came to for a face-to-face lecture classes. Although the mode was different, she managed to use the same material for the online real time sessions: "I am prepared for the course for the on campus student. So now I am going (to use the materials) on Elluminate, They (the students) would have done the reading, it sort of just a bit different mechanism really. So I do not have to prepare anything other than what I would normally do". Using the same resources, Elluminate provide advantages in adding interaction and functionality for building academic and student relationship with the students.

However, for the real time Elluminate session, the expectation is that the students have already done their weekly reading and learning and come to the 2-hours session

for further discussion and clarification for them to understand further and achieve the learning outcome intended for that week:

"The expectation is probably more self-directed learning because I got less time with them (web interactive multimedia technology students)".

She managed to surmount the obstacles and use the web interactive multimedia technology (WIMT). Elluminate, was useful for the neurology graduate course coordinator and students that lived in different suburbs and were scattered across different states and countries. Elluminate also enabled real-time interaction with students. This was more than mere text exchange as the facilitator could communicate verbally, point to graphics and get polling and audio feedback from the students: "It is fantastic! I think it is a fabulous technology".

The technology increased the opportunity for interactively align the objectives, activities and assessment. The number of students that she manages through the technology is small and it enables smooth working functions during the real time session on the web.

Example solutions taken by the university IT services to tackle the problems were creating user groups to faced the technological infrastructure problems and support each other challenges. However, some staff learnt to use the application on their own because it was relatively simple.

Organization thinking about adopting should proactively organize training and user group to enable practices among staff. Staffs need to use the application in a learning environment to assess the useful features and to decide how their curriculum, pedagogy and resources need to change.

These findings show that by implementing WIMT in the university, effective teaching and learning activities that use multimedia can occur across physical space and geographic boundaries. Elluminate in this case used several interactive multimedia features that enabled interaction that could be accomplished by more than just text exchange. The effective use of WIMT in learning, teaching and curriculum design requires a more informed understanding of the expectations of students, staff and institutions, along with preparation for and induction into the use of technology to foster positive learning and student outcomes [11]. The learning constructivism models learning as objective, activity and assessment aligned. Complec-based WIMT augment traditional online environment in the university by enabling more features that provided more opportunity for interaction in building the academic and student relationship.

## 9  Conclusion

In a pilot study, all stakeholders including front line technical support staff should be included and be introduced to the web interactive technology that was piloted and is currently being implemented in the university.

Access to and the ability to effectively use ICTs to obtain information and services are becoming increasingly important requirements necessary to fully participate in contemporary Australian economic, political and social life [15]. Eklund, et al., [15], stated that successful learning required quality instructional content as well as an appropriate context that includes facilitation and an understanding of the learner. The

sharing of images and applications enabled in WIMT provides this quality content and more interaction through pointers and highlighters. However, in this case, the learning is more self-directed. The learner is expected to explore first and then get further clarification and understanding from the real time session with the lecturer.

On using ICT, the educational theory has also had an impact as a theoretical basis upon which to justify content designs [15]. Biggs [21] principles of constructive alignment have fostered an academic environment where students can be confident that a course unit's learning outcomes line up with its learning objectives. In this case, the learning objectives and learning outcomes was provided to the students for their learning of the course.

The technology is seen increasingly as an enabler of learning. In the multimedia and web development industry there is a clear evidence of a gradual maturing of practices, through understanding of user centered design standards and the importance of usability in design [15]. These improvement processes are assisting to create better quality resources which are more efficiently produced and better meet the needs of the target market. The user in this case was able to easily adapt and use the technology without technical assistance or training.

The lecturer supervised the successful deployment and integration of the content into the teaching and learning environment. The lecturer's role was to find, adapt and deliver knowledge using a variety of techniques appropriate to a knowledge domain and the needs of the learner.

The evaluation of web-based learning environment was a continuing process throughout the development lifecycle [22]. Several evaluation approaches could be used to identify problem areas or to draw inferences about the overall quality of web-based learning environment. Several studies consider how effective the user interface system support users' learning activities. This research-in-progress will look at the use of the system features that support end-user's understanding and learning outcomes.

The dynamic nature of learning contexts and appreciation of the fact that even if the environment is stable each semester will be different due to the inherent diversity amongst student cohorts needs to be considered in evaluation processes [12]. Evaluation can be use as method for online education in university learning [23].

This paper provides an overview of Web Interactive Multimedia Technology and issues and opportunities for adoption in higher education. This system provides a flexible environment for academics and learners to communicate across physical space. In particular, the potential in a blended environment are emphasized. It enables learning beyond the traditional boundaries, and that the introduced system provides useful alternatives.

By looking at the WIMT implementation, further improvement to the design issues can be done by looking at the technical issues and integration of features to activities for effective learning. For a small number of students, Elluminate provides opportunities for geographically disparate groups and increases interactivity during learning actuates foe online students.

The WIMT provides real time collaborative feedback between academic and student. It enables synchronous as well as asynchronous features (with its recording facility). This could enhance lifelong learning activity to additionally generate a knowledge based worker and society.

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