



Students' perceptions of interactive multimedia mediated web-based learning: A Malaysian perspective

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While using the Web can be viewed nowadays as a new platform for delivery of course materials, there are still many educators who look to the Web as a replacement for their current teaching methods. This paper sought to investigate students' perceptions towards an interactive web-based learning environment, which consisted of using multimedia-mediated web-based learning modules, created based on Mayer's (2001) design guidelines, and the use of weblogs to capture the student learning process. Students were given pre-and posttests, and a survey to ascertain their reactions and attitudes toward this mode of learning. The results obtained were very positive and encouraging. Students generally found the multimedia-mediated web-based learning environment to be enjoyable and motivating, and were able to demonstrate their learning and skills of the subject domain via their weblogs. Results also gave strong support for the use of multimedia in learning modules that followed proper design guidelines which would better engage students in their learning.

Keywords: student-centred learning, web-based learning, interactive multimedia, malaysia

Introduction

Web learning has become common in classroom teaching with most of the higher education institutions engaging in web learning or some form of online teaching (White and Weight, 2000; Palloff and Pratt, 2000; Alessi and Trollip, 2001). Most of the higher education institutions are engaged in web learning. The popularity of web learning is mainly due to the concept of "anywhere" and "anytime". Universities are becoming more involved in e-learning activities as lecturers are uploading teaching materials onto e-learning systems. When multimedia is introduced, it becomes an attractive feature for such e-learning initiatives. Mayer (2003) strongly posits the use of multimedia as an effective teaching and learning tool, as he stated that, "*the promise of multimedia learning is that teachers can tap the power of visual and verbal forms of expression in the service of promoting student understanding.*" Thus many web learning applications are now designed such that information is presented online in the websites and enhanced with multimedia features and interactivity, and follow certain design concepts (Svensson & Ostlund, 2007). Such a learning environment is deemed to be student-centred as students are empowered with the control and activity of these online modules. In such a learning environment, students are active in their learning process and are involved in acquiring and navigating through the content in the learning modules at their own pace. In Malaysia, the Government is calling for Malaysian institutions of higher learning to integrate ICT into their classrooms, to develop students with skills that would allow them to be effective IT workers in industry (Mat 2000). As such, institutions of higher learning in Malaysian are beginning to incorporate ICT materials in developing e-learning methods and in web-based courses (Hong, Abang Ekhsan & Zaimuarifuddin, 2005, Neo, 2005). However, not all educational applications are designed based on proper guidelines and there is still very little conclusive research in Malaysian classrooms on the impact of multimedia and design factors in web-learning applications on the student learning process.

Interactive multimedia-based learning

Oliver and Herrington (1995) defined multimedia/hypermedia as an "*instructional medium which appears to hold considerable promise for teaching and learning.*" The way information is organised in a hypermedia environment has similarities to the human thought processes. (Oliver & Herrington, 1995).

As a result, many have claimed its promising nature as an ideal learning and teaching tool. In the process of hypermedia learning and interaction, students are influenced by the way the material is structured, presented and processed. With multimedia applications, information can be present in media formats which stimulate the various human senses. According to Reeves (1998), “*multimedia can stimulate more than one sense at a time, and in doing so, may be more attention-getting and attention-holding*” which would enliven student learning. It is also an effective learning tool as it enables users to participate and be involved with the content of the application (Kim & Gilman, 2008). This can be done through the interactive multimedia features built into the content’s instruction and cultivated between user and PC (Agnew, Kellerman & Meyer, 1996). Such interactions make the learning process interactive, responsive and active. Here the learning that takes place is active and would involve the learner’s participation and involvement. The characteristics of such interactive multimedia applications allow learners to be part of the learning process, experiencing control over the content, initiate search, making selections and manipulate the acquisition process. Hence, multimedia places a high degree of responsibility into the hands of the users to drive the learning process.

With the advent of e-learning as an innovative method of teaching educators are provided with more flexibility in creating an exciting learning environment. Furthermore, the incorporation of multimedia elements into the learning environment make the learning modules more attractive to the student. However, not all multimedia elements should be used at the same time and there should be proper combination of certain multimedia elements to achieve the best in delivering the content. Mayer (2001) and Clark & Mayer (2003) sought to address such issues and developed 7 principles of interactive multimedia design, which were adapted into the development of this research’s learning module. Table 1 shows the principles that were mapped to the development of the module.

Table 1: Using Mayer’s (2001) design principles in the learning module

	Mayer’s (2001) design principles	Interactive module
1.	Multimedia Principle: Students learn better from words and pictures than from words alone.	The web module was designed with relevant illustrations wherever needed to further explain concepts in the module.
2.	Spatial Contiguity Principle: Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.	Graphics and text were presented in an integrated manner so as to provide proper combination of the information with both media types.
3.	Temporal Contiguity Principle: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.	Textual information presented together with illustrations were presented simultaneously in order to provide students with strong visual support for the textual information on the screen.
4.	Coherence Principle: Students learn better when extraneous words, pictures and sounds are excluded rather than included.	Images with conceptual relevance, and not merely topical relevance, were included. Sound effects were not added to ALL buttons as they would distract students from the content and students could chose to have background music playing.
5.	Modality Principle: Students learn better from animation and narration than from animation and on-screen text.	Wherever possible, content was presented visually (with still or moving images) or aurally (with narration), and not merely on-screen text.
6.	Redundancy Principle: Students learn better from animation and narration than from animation, narration, and on-screen text.	Content was presented with narration and animation/visual images, instead of animation and text, so that students can listen to the narration while looking at the animation/visual images and not be distracted by identical textual information.
7.	Individual Differences Principle: Design effects are stronger for low-knowledge learners than for high-knowledge learners and for high-spatial learners rather than for low-spatial learners.	The students were undergraduates in their first trimester of classes in University. Therefore, they did not have much prior knowledge on the subject matter and the multimedia web environment. Therefore, this web module is considered a new way of learning to them.

The student-centred web based learning environment

Student-centred learning derived its meaning from an environment where learning was achieved through student’s active participation in learning activities. Reeves (1998) has suggested that interactive learning is student-centred learning. This web-based learning environment draws upon the student-centred approach by allowing the learners to interact with the content on their own. Liaw (2001) posits that hypermedia-based applications are non-linear and allows the learners to explore information in their own ways, making it educationally superior to traditional media as it simulates the real life situation of the students. By allowing students to actively participate in the learning process garnered by learning

activities in such a student-centred environment they become more engaged their learning experience, which can result in the increase of their understanding and retention of the subject matter (Agnew et.al, 1996; Bates and Poole, 2003). Berge, Collins & Dougherty, (2000) posit that "*A continuum of methods can be delivered via Web pages from instructor-led lectures through learner-controlled activities to eventually independent, student-controlled.*" This suggests that creating a successful Web environment means going beyond creating electronic versions of the course. Rather, it should be designed specifically with an interactive, electronic medium that accommodates various media types and be incorporated into the classroom in many ways, from being just a resource to including course activities that go beyond the classroom settings (Bonk, Cummings, Hara, Fischler & Lee, 2000). It should even be designed to be as authentic as possible (Herrington & Herrington, 2006). On the part of the learner, the web-based learning offers them a tremendous opportunity to experience a student-centred environment. It can foster collaborative efforts, create scaffolds, allow reflection, allow students to focus on the depth of the situation rather than the breadth of it, and enable them to become more responsible for their learning via its asynchronous mode of access and delivery (Hung, 2001; Winnips & McLoughlin, 2001; Keengwe, Onchwari, & Wachira, 2008). Thus, the web-based learning environment that was designed in this study consisted of the following:

1. An interactive multimedia web learning module for the students to learn. The module was designed using Mayer's (2001) and Clark & Mayer's (2003) designed principles, and enhanced with web features (Nielsen, 2000), to better engage student learning, and was uploaded to the University web server for access. The learning module can be viewed asynchronously and links to chatting and communication with the lecturer and tutors were made available inside the module.
2. A theme-based assignment that would allow them to incorporate the knowledge and skills from the module, their tutorials and from the Web in general. The assignment was authentic (Herrington, Reeves, Oliver & Woo, 2004) and would be proof of their learning (Winnips & McLoughlin, 2001).
3. Weblogs created by students to demonstrate their development process in their assignment. Students would create these weblogs that were accessible by the class and the lecturers. Such a community would enable students' works to be commented on and assessed for skills and understanding. It would also provide them with a platform to show responsibility for their work and solicit asynchronous feedback and comments from the class community.

Methodology

Subjects in this study were undergraduate students (N=70) enrolled in the Computer Graphics course. The course was design to teach students, with little or not prior knowledge in design or computer graphics skills, the fundamentals of computer graphics and to provide them with skills to design computer graphics using graphics software. Students were told to view the learning module, "*Computer Graphics*", online, and to complete a theme-based assignment called "*Global Warming*", using a computer graphic software Adobe Illustrator, based on their own sketches and ideas for presentation. A weblog site for the class was created on Blogspot.com, to allow students to post their blogs about the creation of their assignment, their conceptual ideas, sketches and their technical skills. These weblogs were accessible to other students as well as to the lecturers and students to comment and assist. Figure 1 shows the interactive module as designed using Mayer's (2001) principles and enhanced with web features such as a word search that would connect students to an online reference, online activities to test their knowledge interactively, and the lecturer's email contact so that they can contact the lecturer when necessary.

As part of their web learning environment, students were asked to use weblogs to discuss and post their development of their assignment to show detailed comprehension of the concepts taught in class.

Students were given a pre-test on the module, and then told to go online to view and study the web module. After viewing the module, they were then given a posttest to gauge their learning. They were also given a survey questionnaire, which was measured in a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), to gauge their attitudes and feedback towards the web-learning environment. Their weblogs were also analysed to assess their learning process in this environment.

Analysis of results

Learning scores from web module

The pre-test was administered a week prior to treatment and contained 20 multiple choice questions on the module topic. Students were then told to go online and view the web module and were administered the post-test after the treatment to assess their learning of the module content. Preliminary analysis of the

learning scores showed that students exhibited a mean increase of 4.11 points after being shown the web module, with their mean scores of 7.93 for the pre-test increasing to a mean score of 12.04 on their post-test. Therefore, after the treatment, the results of students' learning scores showed an increase of 52% in their test scores (see Table 2)



Figure 1: The topic page (right) and the Index page (left) of the web module

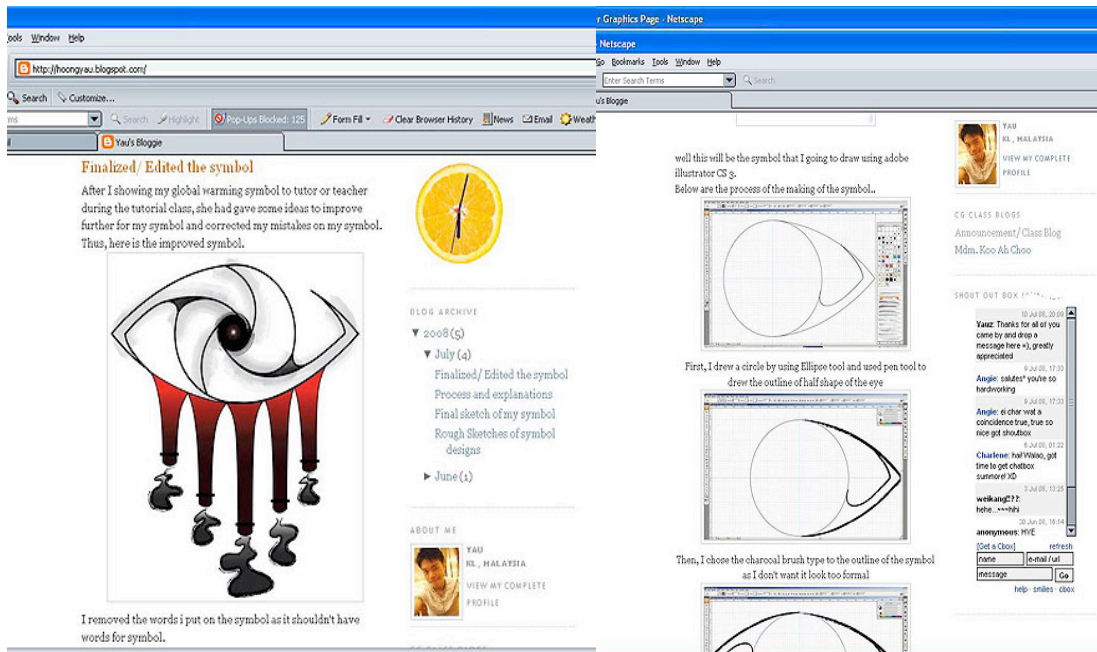


Figure 2: A student detailing his assignment development process on “Global Warming” and the comments on the blog by his colleagues

Table 2: Learning scores (pretest and posttest): Paired samples statistics

Method	N	Mean (Pretest)	Mean (Posttest)	Mean Difference	% change
Web module	70	7.93	12.04	4.11	52

Further analysis was done using SPSS 16.0. A paired sample T-tests was conducted on the test scores and the results are shown in Table 3.

Table 3: T-test results on pretest and posttest scores: Paired samples test

	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pair 1 pre - post	-4.114	3.308	.395	.000

As shown in Table 2, the results of the t-test showed that there the difference between the pre-test and post-test scores were very significant, as $p=0.000$ at a 95% confidence interval ($p<0.05$), and showing an effect size of 1.24 ($4.114/3.308$), showing a strong indication that students learnt from the module. This indicates that the web module greatly contributed to their learning of the content. A test of normality of the distribution (see Table 3) was also performed. Since the Kolmogorov-Sminov ($p=0.00$) and Shapiro-Wilk ($p=0.00$) are significant ($p<0.05$) (see Table 4), therefore a non-parametric test or the Wilcoxon Signed Ranks Test was used to confirm the paired t-test (see Table 5). This further strengthens the t-test score results that students' learning of the content increased after going through the web module.

Table 4: Tests of normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference in scores	.185	70	.000	.896	70	.000

a. Lilliefors Significance Correction

Table 4 Wilcoxon signed ranks test

		Ranks			Test Statistics(d)	
		N	Mean Rank	Sum of Ranks		post - pre
post - pre	Negative Ranks	09(a)	.00	.00	Z	-6.775(a)
	Positive Ranks	60(b)	30.50	1830.00	Asymp. Sig. (2-tailed)	.000
	Ties	10(c)			e. Based on negative ranks.	
	Total	70			d. Wilcoxon Signed Ranks Test	
		a. post < pre b. post > pre c. post = pre				

Student survey and feedback of the web environment

In addition to their learning scores, students were given a survey questionnaire to gauge their attitude toward the web environment. Results of the survey yielded a Cronbach Alpha of .71 which is indicative of strong reliability. As shown in Tables 5 and 7 the items can be categorised into the following areas:

Table 6: Students' attitude towards using multimedia in the module

Item	Use of multimedia in module (N=70)	Mean (m)	Std. Dev (SD)	Percent % (p)
1	Multimedia made learning fun	4.21	.562	92.9
2	Liked having multimedia to illustrate ideas and concepts	4.16	.735	88.6
3	I liked having MM content	4.09	.583	87.1
4	Learn Better with MM	4.07	.598	85.7
5	MM made understand the content better	4.04	.624	82.9
6	The content was clearly presented	4.01	.551	85.7
7	Graphics made it easy to understand	3.97	.613	80.0
8	Design of web module was suitable to learn the content	3.76	.600	68.6

Students' attitude towards the use of multimedia elements inside the learning module

Results showed multimedia-related items scored very high in the survey, with means around 4.0 on the Likert scale. Specifically students, reported that using multimedia made learning fun ($m=4.21$, $p=92.9$), and enjoyable ($m=4.09$, $p=87.1$). Students also reported that the use of multimedia in the module allowed them to learn better ($m=4.07$, $p=85.7$) and understand the content ($m=4.04$, $p=82.9$). The content in the module was clearly presented ($m=4.01$, $p=85.7$) as the multimedia elements in the module properly

illustrated the concepts ($m=4.16$, $p=88.6$) and the graphics in the module made understanding the content easy ($m=3.97$, $p=80.0$). Overall, the students found the design of the module suitable for them to learn the content ($m=3.76$, $p=68.6$). In support of the survey results, students were also solicited for their comments and feedback as shown in Table 7

Table7: Students comments on the use of multimedia in the module

Learning with the multimedia-based web module	
a.	Provide more knowledge regarding this course.... Easy to navigate.
b.	It displays graphics to show what the content means. Diagrams and interactive notes helped me to learn better.
c.	The content is organised well and examples of graphics are given.
d.	They give good and direct info included with illustration. At least it wasn't draggy and boring ... Guide me to do the assignment.
e.	The learning style through the use of multimedia made it fun.

From these comments it can be seen that many of them stated that the multimedia elements in the module helped ease and simplify the understanding of the content and allowed them to visualise the information, which then helped them to do their assignment. It provided a fun element to the learning process and enhanced their learning of the material.

Students' attitude towards the web environment

With respect to their attitudes towards the web environment (see Table 8), students reported liking the ability to search the web while learning from the module ($m=4.67$, $p=82.9$), and appreciated web supporting features such as links to other websites for more information, and chat and email capabilities ($m=4.59$, $p=82.9$). A large majority of students reported being able to learn at their own pace ($m=4.27$, $p=92.9$), found the environment interesting ($m=4.09$, $p=90.0$) and therefore preferred this learning environment ($m=4.17$, $p=92.9$), and learning method ($m=3.84$, $p=75.7$) than to traditional lectures ($m=3.91$, $p=70.0$). Interacting with the web environment was fun for them ($m=3.84$, $p=72.9$) and made them engaged in the content ($m=4.09$, $p=90.0$) and motivated ($m=3.84$, $p=74.3$) to learn more about the topics ($m=3.91$, $p=80.0$) and the rest of the content ($m=3.89$, $p=78.6$) on the web.

Table 8: Students' attitude towards the web environment

	Item (N=70)	Mean (m)	Std. Dev (SD)	Percent % (p)
	Attitude towards the web environment			
9	Able to search on the web for more info	4.67	4.821	82.9
10	Able to use web features to support learning	4.59	4.720	82.9
11	I liked being able to learn at own pace	4.27	.588	92.9
12	I enjoyed learning in this web environment	4.17	.538	92.9
13	I found learning on the web engaging	4.09	.531	90.0
14	Prefer web module to traditional lectures	3.91	.756	70.0
15	I am interested to learn more about the topic	3.91	.608	80.0
16	Interacting made me want to learn the content	3.89	.603	78.6
17	I was motivated to learn on the web	3.84	.629	74.3
18	Interactive features made learning fun	3.84	.651	72.9
19	I like this learning method	3.84	.605	75.7
20	Presence of Lecturer	3.60	.923	58.6

There was a fair number of students (31.4%) who were undecided as to whether they were able to learn better without the physical presence of the teacher ($m=3.6$, $p=58.6$). This is possibly due to the fact that this environment was new to them, and although it presented them with an exciting opportunity to learn, it did not allay their fears that only with teacher physically present would they actually learn. This is as a result of the current Malaysian secondary education system, where the traditional face-to-face method is dominant. However, even though they were unsure of the impact of the presence of the lecturer, they were still positive towards the new web learning environment and multimedia technology.

Table 9: Students comments on the web environment

Attitude towards the web environment
a. It was nice, attractive and better than the traditional teaching style. b. Easy to search and find information...in wikipedia, disctionary, etc. c. Really user-friendly and very interactive... It makes me know how to learn more interactively. d. It helped me to understand or help me to search the answer that I want about the topic. e. Able to read/gain info whenever/over and over again. f. Increase my understanding about the subject....Can be updated with the latest info. g. Able to learn at my own time....I could revise it whenever I want. h. It's a new way of learning for me, so it's fun i. I can use the web module to discuss the problems and obstacles that I faced in study

Again, the survey results were supported by student feedback (see Table 9). Many reported enjoying the environment's search features, user-friendliness, design, fun factor and access. Aside for the novelty effect, students commented that learning in this environment was better and allowed them to be more of a community of learners to discuss problems and obstacles in their assignments. And finally, students were also asked for their feedback about using blogs in their learning environment. Table 10 shows some of the comments.

Table 10: Students' comments on using weblogs

Attitude toward using blogs in learning [I like blogging because..]
a. It's better for people to comment on it, because I believe it's a way to improve. I can comment on my friends and they can comment on me. b. Easy to get comment from lecturer or tutor so that can improve on mistakes made. c. I love blogging..keeps me up with my activities...plus I like writing. d. It's like a diary where you record all your research and works, plus everyone else [in the world] can read it and give opinions. e. ..a place to express yourself and ..get the lecturer to check on the progress of the work. f. I can use the blog for my future portfolio and be sure that im doing the right thing..

As can be seen from these comments, students enjoyed using weblogs to document, share and communicate with each other and the lecturer/tutor. They saw the web environment as a platform to access, search and acquire knowledge, as well as to communicate and disseminate information to their peers and teachers.

Discussion

From the study of the student survey, interviews and feedback, it is clear that when the Web-based learning environment was used as the instructional delivery method, it impacts on student learning in many respects. The following discussion presents some of the important aspects which influence greatly the student learning process.

The web learning environment

From the results, it can be concluded that using multimedia in a web-learning module was successful in providing students with various modalities to support their learning. The combination of visual and auditory media elements according to Mayer's (2001) and Clark & Mayer's (2003) design principles were effective in enhancing students' understanding of the subject matter and motivated them to learn more about it through its adaptable web features (Nielsen, 2000) such as flexibility of learning hours and quick access to information and learning not fined to classroom. Moreover, in the web module, extensive links to outside information resources can be provided. The students found this access to outside links on the Net reinforced their knowledge of the subject domain. The use of weblogs enabled them to create a community of learner and helpers in the class and helped them to solve their design problems, socialise, and keep track of their progress. The use of the web in this environment allowed students the flexibility and the autonomy to learn at their own pace, search for additional information on the web pertaining to questions they had while interacting with the content, and to communicate with others during their learning process and is in line with Keengwe, Onchwari, & Wachira's (2008) position that such an environment would facilitate more active learning capabilities among learners.

The changing role of the students, teacher and technology

In this learning mode, students were actively pursuing their learning on their own while the teacher acted as a guide to facilitate their learning. They set their own pace in their learning process. The majority of

the students expressed that they found this mode of learning enjoyable and fun. The environment was engaging to them as it was authentic and relevant to them, supporting the position of Herrington et. al (2004) and Herrington & Herrington (2006), and they were able to interact with the application, with the teacher, and with their own peers to enhance their learning process. Students experienced some autonomy and responsibility in their learning, as posited by Hung (2001), which made them more motivated to do better. From the student surveys, interviews and feedback, it was evident that students liked their freedom in learning process and found that this learning process was interesting and engaging, useful and increased their understanding of the subject domains. Such successful active participation is reflected in the significant increase in their posttest scores and in their survey comments and showed that students were able to learn in this web learning environment. Technology also became an important component in that the teacher would also have to be technically-inclined to cultivate a technology-oriented culture in the classroom.

The use of multimedia in the module

In this learning environment, multimedia images such as graphics, animation and videos were used to present the instructional content. By successfully incorporating Mayer's (2001) design principles for multimedia, the learning module was effectively designed to properly engage students in learning. From the research findings, students expressed that this had great impact on their learning. They found that the graphics and multimedia elements very useful for them to visualise key concepts and enhance their understanding of the subject. They expressed strongly that the multimedia elements in the module increased their motivation to learn, made their learning fun and kept them actively engaged in their learning and is in line with Reeves' (1998) and Kim & Gilman's (2008) positions on the effectiveness of multimedia in learning. Interactivity within the learning module also had an important impact on student learning as this feature provided students with a navigation system in the module which enabled them to navigate around the module. This facility allowed students to determine their path of learning as well as the pace of learning, which led them to enjoy their learning process.

Conclusion

An interactive multimedia web-based module was created using Mayer's (2001) and Nielsen's (2000) design principles and incorporated into a web-based student-centred learning environment to investigate students' perceptions towards this learning environment in the Faculty of Creative Multimedia. Results showed that the students enjoyed and felt motivated in their learning when interactive learning was used as a delivery method to communicate knowledge and information to them. They liked the self-paced learning process and the autonomy in determining their own learning path. They also liked using multimedia in their learning process as the multimedia elements helped them to visualise key concepts and understand key points in the content. This method of interactive learning enhanced and increased their understanding of the subject domain and engaged them actively in their learning process. This learning environment was positively received by students and further research is underway to investigate such a learning environment on non-IT computing students to shed more light on the area. Thus this research study was able to provide further support for educators interested in incorporating multimedia and web-based modules in student-centred learning environments in Malaysia.

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