

## **Technology-Enhanced Constructivist Learning in The Classroom: Students' Perceptions**

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### Abstract

During the last decade, multimedia technology has permeated the Malaysian education scene and has created a significant impact on the teaching and learning methods in the Malaysian classrooms. This study focused on designing a constructivist-based course using multimedia as an instructional tool, and investigated its impact on the student learning process. A multimedia design project was given to the students to create, and a student learning process which was mapped to the seven problem-solving pedagogical goals (Cunningham, Duffy & Knuth, 1993), was undertaken to complete it. Students were then given a survey and their feedback was solicited after the project was completed. A Constructivist learning environment, enhanced by multimedia technology, called the multimedia-mediated constructivist learning environment, MMCLE, was developed. Results showed that students were very positive towards the MMCLE and gained constructivist learning skills that were integral to their future. The study thus showed that by effectively integrating multimedia technology into the curriculum, the teachers will have more flexibility and scope in teaching and a technology-enhanced constructivist learning environment can be created whereby learning becomes a social activity and students become active participants in their learning process.

Keywords: Multimedia learning, project-based, Malaysia, Multimedia University, Constructivist learning

### Abstrak

Sejak sedekad yang lalu, penggunaan teknologi multimedia telah semakin meluas di dalam sistem pendidikan Malaysia dan ianya telah memperlihatkan kesan yang memberangsangkan kepada kaedah pengajaran dan pembelajaran di dalam bilik darjah di Malaysia. Kajian ini tertumpu kepada merekabentuk kursus konstruktivis yang berasaskan penggunaan multimedia sebagai alat pengajaran dan mengkaji kesannya terhadap proses pembelajaran pelajar. Satu projek reka bentuk multimedia telah diberikan kepada pelajar untuk mereka mencipta, dan proses pembelajaran pelajar itu yang telah dipetakan kepada tujuh matlamat pedagogi penyelesaian masalah (Cunningham, Duffy & Knuth, 1993) telah diambil untuk melengkapkannya. Pelajar kemudiannya diberikan satu kaji selidik dan diminta untuk memberikan maklum balas selepas projek tersebut selesai. Persekitaran pembelajaran konstruktivis yang dipertingkatkan dengan multimedia sebagai pengantara, MMCLE, telah dibangunkan. Hasil kajian menunjukkan pelajar sangat positif kearah MMCLE dan mendapat kemahiran pembelajaran konstruktivis di mana ianya amat penting terhadap masa depan mereka. Oleh itu, kajian ini menunjukkan bahawa dengan mengintegrasikan teknologi multimedia yang berkesan ke dalam kurikulum, guru akan mempunyai lebih banyak fleksibiliti dan skop dalam pengajaran dan peningkatan teknologi di dalam persekitaran pembelajaran konstruktivis boleh diwujudkan di mana pembelajaran menjadi aktiviti sosial dan pelajar menjadi peserta aktif dalam proses pembelajaran mereka.

*Kata kunci: Pembelajaran multimedia berasaskan projek, Malaysia, Universiti Multimedia, Pembelajaran Konstruktivis*

## INTRODUCTION

The Malaysian Government, like many countries in the world, is giving strong support to using technology, particularly the Information and Communication Technology (ICT), in teaching and learning in the higher educational institutions (Mat, 2000). Currently, constructivist learning is becoming a dominant educational learning theory in education and multimedia technology has become an important component in enhancing the motivation and learning process of students (Agnew, Kellerman & Meyer, 1996, Neo and Neo, 2003, Neo and Neo, 2004).

Research on the mismatch of skills lacking in today's graduates, such as creativity, critical-thinking, problem-solving and communication skills (Teo & Wong, 2000, Siaw, 2000, Tan, 2000), have resulted in many Malaysian classrooms using constructivism and multimedia to enhance the teaching and

learning process. Research in Malaysian education has shown that constructivist-based approaches can lead to increased problem-solving skills (Lee, 1999, Hong, Lai & Holton, 2003), enhanced learning in e-learning environments (Suraya, 2005), and enabled teachers to better transfer their knowledge to their students in the classrooms (Wong, Kamariah & Tang, 2003). However, despite the efforts to progress towards more student-centred methods of teaching and learning, Malaysian institutions of higher education still need to further study the use of constructivism and multimedia technology. As such, this study seeks to further the investigation of constructivism and multimedia through the design and development of a technology-enhanced learning environment using multimedia as an instructional tool.

## **LITERATURE REVIEW: THE CONSTRUCTIVIST LEARNING PARADIGM**

In the past few decades, constructivism has gained prominence in the education arena, not only as a broad movement but also as an education strategy (Muijs and Reynolds, 2005), as 'Constructivism constitutes a very important, although often contested, practical and theoretical perspective in current education research' (Boudourides, 2003).

Many researchers found this learning perspective valuable as it contributes to effective learning, where 'Learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge' (Bruner, 1985) Using their pre-existing knowledge, learners learn through their personal involvement and experience in order to construct new knowledge, and then obtain critical-thinking skills, therefore focusing on learning 'how to think and understand' rather than on rote memorization. As stated by Vygotsky (1978), social interactions are seen to play a critical role in the processes of learning and cognition, and therefore, a collaborative setting that promotes social and communication skills initiates learners to collaborate, explore and exchange ideas in order to solve the given problems. Piaget (1952) had stated that constructivist learning has received increasing attention in the education community in recent years because of its emphasis on the active role played by the learner as he or she acquires new concepts and procedures. Likewise, advocates of constructivism agree that acquiring knowledge or knowing is an active process of constructing understanding rather than passive receipt of information.

Cunningham, Duffy & Knuth (1993), stated that to create a constructivist learning environment (CLE), the learning settings should contain the seven pedagogical goals that must simultaneously:

1. Provide experience in the knowledge construction process
2. Provide experience in and appreciation for, multiple perspectives
3. Embed learning in realistic and relevant contexts
4. Encourage ownership and voice in the learning process
5. Embed learning in social experience
6. Encourage the use of multiple modes of representation
7. Encourage self-awareness in the knowledge construction process

The advent of multimedia technology has created a new arena in learning. Educators began to switch attention into the new directions through technology resources to motivate learning (Roblyer and Edward, 2000). With the emerging technologies, students are expected to learn in various ways other than the traditional "chalk & talk" teaching method. Multimedia creates ideal environments for constructivist learning activities in which learners are engaged in their learning process. The unique capabilities in multimedia are able to help to gain and hold attention, make points clearer, and stimulate discussion, facilitate learning with motivation, flexibility and creativity (Duffy and Jonassen, 1991, Jonassen, 1994, Jonassen, Peck and Wilson, 1994). It is also able to improve critical-thinking, writing and process skills. Additionally, multimedia motivates learners to express their ideas and display their information in various ways (Neo, 2003). There are many ways to improve instructional materials and to help instructors and learners improve the teaching and learning environment. Some technological media can facilitate unique learning environments or contribute unique features to make traditional learning environments more powerful and effective. Roblyer and Edwards (2000) proposed technology integration strategies based on constructivist models:

- Generate motivation by capturing learners' interest and enthusiasm
- Foster creativity by revising creative resources
- Facilitate self-analysis and metacognition by raising their consciousness towards procedures in problem-solving.
- Increase transfer of knowledge to problem-solving by using highly visual environment.
- Foster group cooperation as it motivates learning and ease task accomplishment.

- Fosters multiple and distributed intelligences and enhance learners' self-esteem and increase their willingness to spend work on learning tasks.
- Develop technological and visual literacy to provide practice in using modern methods of communicating information.

In this research project, a multimedia design project was incorporated into a constructivist learning environment (CLE). This involved solving a multimedia design problem, which allowed students to engage in problem-solving where the learning activities provided the constructivist learning framework. As stated by Savery and Duffy (1995), the learning activities generated by solving a design-oriented problem are constructivist in approach. In other words, in this study, the multimedia learning activities reflected the constructivist perspectives as contained in the seven pedagogical goals stated by Cunningham et al. (1993) (see Table 1). This research project contained these seven pedagogical goals and hence is constructivist in the learning approach. The objective of the study was to study and present student perceptions on the impact of a multimedia constructivist learning environment in the classroom as an innovative teaching and learning method.

## **METHODOLOGY**

In order to complete the project, students would engage in constructivist learning activities such as solving an authentic and realistic design problem, in support of Herrington, Reeves, Oliver and Woo's (2004) position of effective constructivist-based learning via an authentic setting, and constructing new knowledge, using multimedia technology which would promote active learning in the classroom, engaging in social interaction and collaboration with peers, which would lead to knowledge seeking and sharing activities, and acquiring presentation and reflection skills. The constructivist learning environment was created using the course Interactive Multimedia offered by the Faculty of Creative Multimedia (FCM) in Multimedia University. A total of 53 (N=53) 2nd year students from three different faculties in the University, the Faculty of Management (FOM), Faculty of Engineering (FOE) and the Faculty of Information Technology (FIT), pursuing their Bachelors of Multimedia (BMM) degree, participated in the study. These were students who had little or no background in design foundations, multimedia principles and interactive multimedia development. A multimedia design project was introduced to the class and students would work in groups of 4-5 members to complete it

using Macromedia Director, which was taught in tutorials, and to present the final interactive multimedia application at the end of the trimester on a CD. As part of an authentic setting for the learning environment, teams were required to develop interactive multimedia prototype applications on CD-ROMs based on the class theme 'Malaysian Culture' for the Malaysian Tourism Board. The teams had 14 weeks to complete this project.

There were 4 phases in the development in this learning environment which the students underwent in order to complete their projects. These phases marked the various stages of development of their work, and included several in-progress reports and presentations and include 1) The initial development and forming of groups, 2) Formalising and planning the project, 3) Authoring the project and 4) Presentation and submission of project. The activities involved in the design of this multimedia project, the 4 phases, reflected the various characteristics of the Constructivist learning environment, which had embedded in it the seven pedagogical goals of Cunningham et al. (1993). Table 1 shows the 4 phases of the multimedia project development corresponding to the 7 pedagogical goals, and Diagram 1 illustrates it diagrammatically.

According to George and Cowan (1999), not all evaluations call for separate activity to generate data; some may use data that are already available, such as portfolios, learning journals and examination scripts. They also stated that learning should be evaluated by finding out what students have actually learnt, not by what they think they have learnt. Hence, the final data collection method used was to evaluate the applications done by the students. It would be the strongest proof of

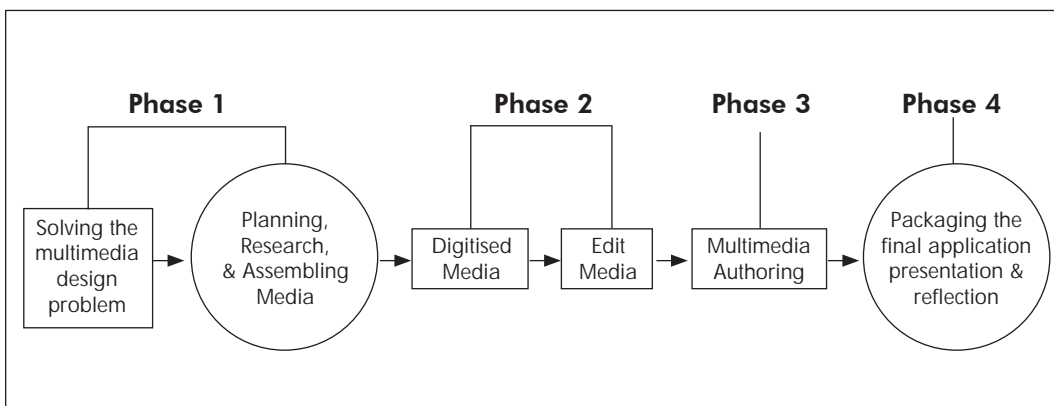


Diagram 1: The students' development process

Table 1: The learning activities of the 4 phases corresponding to  
Cunningham et al.'s (1993) 7 pedagogical goals

The 7 pedagogical goals in constructivist learning	Corresponding activities of the 4 phases in multimedia project development
<p>Embed learning in realistic and relevant contexts Encourage ownership and voice in the learning process</p>	<p><b>Phase 1: The initial development and forming of groups.</b> Students were told of their design problem, which was to design an interactive CD application on the theme "Malaysian Culture" for the Malaysian Tourism Board. This was a project theme that was realistic to their working future and relevant to them. Students were required to form their teams and to submit their first report which contained the group names, and proposed topic for the project. The final application created by them belonged solely to the group, thus providing them ownership over their work, and they were given the freedom to determine their project's topic, learning goals, execution and research methods to develop and produce their own multimedia project.</p>
<p>Provide experience in and appreciation of multiple perspectives Embed learning in social experience</p>	<p><b>Phase 2: Formalising and planning the project</b> Students brainstormed and formalised their concepts and ideas by creating sketches and interfaces for their applications. Teams were already undergoing various group meetings and discussions, tasks were delegated, and groups had begun to create storyboards and conceptualized their project topic, finalize the milestones created by the team to outline the key activities of their project development and their corresponding deadlines. They also conducted their own meetings via the Web, usually using Yahoo, during times when they could not meet. Teams would then present their storyboards to the class for feedback and comments.</p>

Provide experience with the knowledge construction process  
Encourage the use of multiple modes of representation

### Phase 3: Authoring the project

The multimedia project permitted team to use a variety of media to provide a richer learning environment by representing information in fun, creative and innovative ways. Here teams were engaged in constructing knowledge to solve their problems. They applied their previous knowledge in multimedia and their skills and translated their conceptual and storyboard ideas by developing the digital application on Macromedia Director. They were encouraged to use other third-party software supported by Director to enhance their application. Many used Photoshop, Swish, Premier and Flash to add graphics, sound, video and animation elements to their applications.

Encourage self-awareness of the knowledge construction process.

### Phase 4: Presentation and submission of project

There were 2 presentations in the class, a work-in-progress presentation for feedback on their concept, use of multimedia, interface design and navigational structure, in order for them to identify areas for improvement, and a formal presentation of their finished application. These team presentations provided students with the opportunity to present and defend their application to the class, and to highlight their development process, as well as to allow them to experience an authentic activity associated with project development in the real-world. At the end of the 14 weeks, they submitted their CD and their reports of their progress and journal reflections, for evaluation.

hands-on skills achieved and increased multimedia knowledge that the students would have acquired since the beginning of the project. Winnips and McLoughlin (2001) also stated that student applications are 'proof of their learning'. Diagram 2 shows some examples of one team's application on **'The Peranakan Legacy: Baba-Nyonya'**, a Malaysian heritage group.

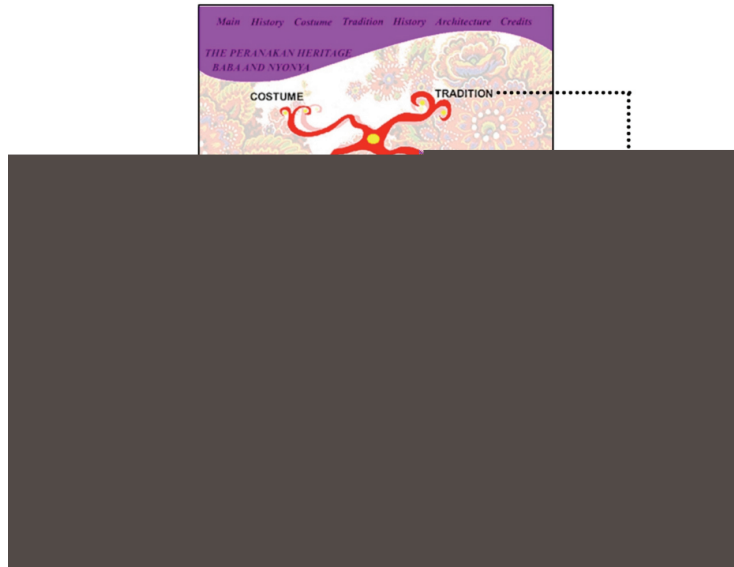


Diagram 2: The menu page and the corresponding links for the interactive application 'The Peranakan Legacy: Baba-Nyonya'

## FINDINGS

Students were given a 20-item survey questionnaire adapted from Neo and Neo (2001) and Diamond (1998) with items on their attitudes and perceptions towards the project and the learning environment. The survey was measured using a 5-point Likert Scale which begins with Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4) and Strongly Agree (5). The sample size was 53 students (N=53). The data were analyzed using SPSS (Statistical Package for Social Sciences) version 11.0, and yielded a Cronbach Alpha coefficient of 0.821, which satisfied the requirement of survey reliability (Lim, Khine, Hew, Wong, Shanti & Lim, 2003.) Analysis on the survey items showed that the overall average means and percentages of responses towards the 4 constructivist constructs were favourable (i.e., students responding 'Agree' or 'Strongly Agree' in the scale) and are reported in the following categories:

- Motivation
- Enhanced knowledge and understanding
- Teamwork and collaboration
- Skills acquisition

## MOTIVATION

The motivation construct produced two highly rated items with 92.5% of students finding the project challenging yet inspiring ( $m=4.2$ ). The hands-on experience and the authentic setting of the project resulted in students reporting that they felt motivated to be involved in the project ( $m=4.0$ ,  $p=83$ ) and that project was presented very well using multimedia technology ( $m=3.6$ ,  $p=58.5$ ). 73.6% of students found the individual and group assessments to be encouraging to them to provide their full commitment to the project development ( $m=3.8$ ), and 83% reported having gained confidence in their acquired skills ( $m=3.9$ ), resulting in 69.8% reporting an overall satisfaction with their performance in the learning environment ( $m=3.8$ ). The survey was also supported favourably by students' comments and feedback from interviews and open-ended items from the survey. Many reported feeling happy and highly motivated to do the project, even though they were aware that it would be challenging. The results for the Motivation construct is shown in Table 2 below.

Table 2: Means and percentages for the Motivation construct

No	Items (N=53)	Mean (m)	% (p)
<b>Motivation</b>			
1.	Challenging yet inspiring project	4.2	92.5
2.	I felt motivated to involve myself in project	4.0	83.0
3.	The individual & group assessments encourage me to give full commitment	3.8	73.6
4.	Project presented well using multimedia technology	3.6	58.5
5.	Gained confidence in acquired skills	3.9	83.0
6.	Overall, I am very satisfied with my performance	3.8	69.8

### Feedback and comments from students on **Motivation**

1. "I feel very happy and satisfied with the result. It made me feel everything is worth it."
2. "We are highly motivated. Seldom do we get to expose on doing this kind of project."
3. "It's challenging but it's very hard, it's very difficult sometimes. But we feel satisfied and motivated to move on when it is solved."

## ENHANCED KNOWLEDGE AND UNDERSTANDING

Students also reported favourable attitudes and perceptions towards items that measured their enhanced knowledge and understanding on the subject matter based on the project. They also reported that the project increased their understanding on managing and developing a multimedia application ( $m=4.1$ ,  $p=90.6$ ). Students also reported a willingness to change to keep growing ( $m=4.2$ ,  $p=90.6$ ). 86.8% of students also reported a willingness to accept critical/negative comments ( $m=4.1$ ) in order to acquire proper attitudes and appropriate methods of acquiring knowledge, and placed emphasis on learning in the project rather than merely studying for exams ( $m=3.9$ ,  $p=73.6$ ). The results were supported by the students' comments and feedback. They also commented positively on their enhanced understanding of the subject matter after project development. Results of the students' comments showed that they felt able to apply their newly acquired knowledge effectively allowing them to understand the course better. This is shown in Table 3.

Table 3: Means and percentages for the Enhanced knowledge & understanding construct

No	Items (N=53)	Mean (m)	% (p)
<b>Enhanced knowledge &amp; understanding</b>			
1.	Willing to change to keep growing	4.2	90.6
2.	Accept critical/negative comments	4.1	86.8
3.	Place emphasis on learning in the project than studying for exams	3.9	73.6
4.	Project increased my understanding	4.1	90.6

Feedback and comments from students on **Enhanced knowledge & understanding**

*"In class, we only study the theories. But in this project, we get lots of hands on practices, hence understand the whole idea, and we can develop something together."*

*"We get to apply everything we learn in the project...Therefore this project makes us understand this course better."*

*"... If there isn't a project like this, we need to study very hard to understand."*

## TEAMWORK AND COLLABORATION

In the teamwork/collaboration construct, students were measured on their willingness to participate as team members and support the team goals. Results showed that students were very positive towards working in teams. 77.4% of students reported a willingness to make improvements to keep project growing ( $m=4.0$ ). They also reported a willingness to pay the price to ensure growth of group and showed concern towards learning and team building ( $m=3.9$ ,  $p=73.6$ ). It was also reported that the teams were able to resolve problems together ( $m=3.9$ ,  $p=79.2$ ) and in a positive manner ( $m=4.0$ ,  $p=83$ ). The survey also showed that a majority of them were able to manage their group effectively ( $m=3.6$ ,  $p=62.3$ ), and 62.3% reported that the smooth interactions in the group helped tighten the bond among their members ( $m=3.7$ ). Students' comments from the survey also showed a favourable and positive attitude towards teamwork and collaboration. Feedback from students in Table 4 also showed that teamwork was an integral part to the successful completion of the project. Some found the benefits of teamwork as they are able to learn more knowledge than expected, as shown in some of their comments below:

Table 4: Means and percentages for the Teamwork & Collaboration construct

No	Items (N=53)	Mean (m)	% (p)
<b>Teamwork &amp; collaboration</b>			
1.	Smooth interactions tightened the bond among members	3.7	62.3
2.	Willing to pay price to ensure growth of group	3.9	73.6
3.	Able to manage group effectively	3.6	62.3
4.	Willing to make improvements to keep project growing.	4.0	77.4
5.	Team resolve problems together	3.9	79.2
6.	Team solve problems in positive manner	4.0	83.0

Feedback and comments from students on **Teamwork & Collaboration**

*"Of course in a team, each member will do a part, everyone contribute something, and it will save us a lot of time. We can also discuss and meet up for the project. We can also learn from each other."*

*"When we are in a team, we get to help each other....in fact we have some plans to work together in the following project."*

*"But I think it is a good thing because we learn from each other as we have strength and weaknesses."*

## SKILLS ACQUISITION

The survey results showed that 81.1% of students experienced critical-thinking skills ( $m=4.0$ ) and an improvement in their presentation skills ( $m=3.6$ ,  $p=56.6$ ). Students also reported that they were able to develop skills that were needed in real-world ( $m=3.9$ ,  $p=79.2$ ), as well as being able to apply their newly acquired skills in a more valuable manner on upcoming projects ( $m=4.1$ ,  $p=86.8$ ). In support of the results from the survey, students reported that they were able to gain various skills and experience from doing the multimedia project. They also reported that these skills allowed them to confront future projects without fear. As shown in Table 5, some of their comments were as follows:

*Table 5: Means and percentages for the Skills Acquisition construct*

No	Items (N=53)	Mean (m)	% (p)
<b>Skills acquisition</b>			
1.	Presentation skills developed and improved	3.6	56.6
2.	Capable of thinking critically	4.0	81.1
3.	Developed skills needed in real-world	3.9	79.2
4.	Able to apply skills	4.1	86.8

Feedback and comments from students on **Skills acquisition**

*"Our knowledge for multimedia technology now is much better."*

*"At the beginning we do not know anything about director...Because of this project, we have to solve problems by ourselves... So for sure we learnt and know more than beginning."*

*"Our skill level improves quite a lot."*

## DISCUSSION AND CONCLUSION

In this research, the multimedia project, being an ill-structured, authentic design problem, formed the core of the constructivist learning activities engaged by the

students. The activities involved in designing the project encouraged active learning and participation from the students and was able to simultaneously satisfy the seven pedagogical goals proposed by Cunningham et al. (1993). From the results of the student survey and feedback, the impact of this learning environment on student learning and the learning process can be discussed through these 4 constructs: 1) Motivation, 2) Enhanced knowledge and understanding, 3) Teamwork and collaboration, and 4) Skills acquisition (see Diagram 3).

## **1. Motivation**

Motivation is seen as the pivotal component to learning as it directly influences students' goal achievement as well as self-efficacy. A steady rise of motivation level was observed during the authoring stages. Many teams reported satisfaction and happiness towards the learning process and projects completion. They also reported new-found confidence in taking new challenges in their future.

## **2. Enhanced Knowledge and Understanding**

Most of the students became active learners and were able to construct new



taught in class into practice. With that, they were able to see its relevance to real-world situations. This supported the evidence of effective learning and increased understanding of the subject domain.

### **3. Teamwork and Collaboration**

Teamwork and collaboration were the other important elements that impacted on the project development and consequently the learning process. Students were keen on team work as they envisioned shared responsibilities, knowledge, ideas and skills. They believed knowledge and knowledge-sharing would enhance their skills and improve learning. In conjunction with that, interaction was the key component in teamwork. Therefore team members needed to communicate to understand team members' ideas and needs towards achieving desired outcome and also tightened the bond in the team, thus avoiding project management problems. Students favoured Yahoo! Messenger as their communication channel because they received instant feedback without having to affect their production time, and thus team members were more productive, contributed to project completion and gained knowledge. Working in a team led to unexpected problems. Therefore good group management skills were needed to ensure smooth teamwork for learning.

### **4. Skills Acquisition**

Skills acquisition was also measured during project development as it showed a strong relationship to effective learning. The multimedia project enabled students in planning their learning goals and students enjoyed the discovery process. Problem-solving skill, multimedia execution skills, research skills and critical thinking skills were explored and experienced during the project development. Students felt increased self-esteem and happiness upon acquiring such skills.

Results of this study has also shown that multimedia technology, when incorporated into a constructivist-based learning environment, via a multimedia project, was successful in enhancing the student's learning process, resulting in the development of a technology-enhanced multimedia-mediated constructivist learning environment, or the MMCLE. As a learning environment, the MMCLE effectively mapped and incorporated the student learning activities as contained in the seven pedagogical goals proposed by Cunningham et al. (1993). The impact of this MMCLE was tested on the students' learning and revealed enhanced skills



acquisition, enhanced knowledge and understanding, increased teamwork and collaboration as well as increased motivation in learning, with a majority of students reporting that this learning environment was beneficial to their learning process (see Diagram 4). The significant features of the MMCLE were categorised into: 1) The student learning mode, 2) The student learning activities and 3) The student learning attitudes (see Diagram 4).

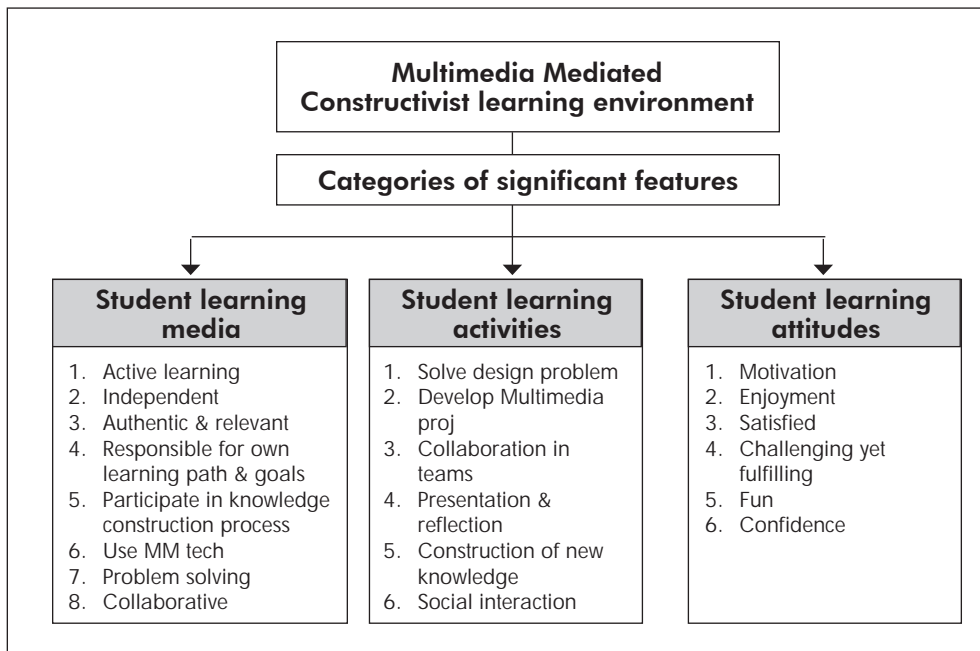


Diagram 4: The MMCLE

The student learning mode referred to the learning process in this learning environment which involved active learning, where students had to be independent in knowledge-seeking, were responsible for their own learning path and learning goals, and participated in knowledge construction process. The learning setting was authentic and relevant to the real-world settings in which students used multimedia technology to solve problems in a collaborative learning environment.

The student learning activities referred to the activities students performed in this learning environment. In developing the multimedia project, students interacted with their team members to understand each other's ideas and needs and collaborated with others in executing their tasks and in solving the design problem. Through this

environment, students not only constructed new knowledge but were also involved in presentation and reflection on what they have learnt.

Student learning attitudes referred to the students' feelings towards this learning environment. Students perceived increased motivation in their learning, enjoyed working in a team and felt that it was fun working on a multimedia project. Students were fulfilled and satisfied with their learning outcome although it was a challenging experience. When the students finally obtained skills acquisition and knowledge enhancement, they felt increased self-esteem, and therefore were confident to get involved in future projects.

## **DISCUSSION AND CONCLUSION: THE MULTIMEDIA-MEDIATED CONSTRUCTIVIST LEARNING ENVIRONMENT (MMCLE)**

Consequently, the results provided more insight into the development of the essential features for this MMCLE. In this authentic learning environment, students were active and independent in their learning process and participated in their knowledge construction process. The MMCLE allowed them to be responsible for their own learning path and goals and experience problem-solving and collaborative skills with the support of multimedia technology.

Social interactions and student collaborations were prominent in the MMCLE. By working in teams, students engaged in active group collaboration activities to construct and share new knowledge. The MMCLE further created a learning environment where students experienced increased motivation and enjoyment levels in their work. They had fun working in their teams and engaging in group-based activities, and were satisfied with the learning outcome. This resulted in an increase in students' perceived confidence levels to undertake similar projects in future settings. Thus, these MMCLE features provide encouraging results to the further development of constructivist-based learning activities in classrooms and other learning environments.

In conclusion, the findings from this study have lent support to the view that utilising a multimedia project in a constructivist learning environment can provide strong learning support for students and will create opportunities to cultivate positive and collaborative working environments as they make appropriate choices in the knowledge construction process. Hence, this research study has given a positive support for the creation of the MMCLE as a practical guide to other educators in technology-enhanced classrooms.



## REFERENCES

- Agnew, P. W., Kellerman, A. S., and Meyer, J. (1996). *Multimedia in the Classroom*. Boston: Allyn and Bacon.
- Boudourides, M.A. (2003). Constructivism, Education, Science, and Technology. *Canadian Journal of Learning and Technology* [Online], 29(3). Available: [http://www.cjlt.ca/content/vol29.3/cjlt29-3\\_art1.htm](http://www.cjlt.ca/content/vol29.3/cjlt29-3_art1.htm) [2006, January 25].
- Bruner, J. S. (1985). Models of the learner. *Educational Researcher*, 14 (6), 5-8.
- Cunningham, D.J., Duffy, T.M. & Knuth, R. (1993). The Textbook of the Future, In C. McKnight, A. Dillion & J. Richardson (Eds.), *Hypertext: A Psychological Perspective*. Ellis Harwood.
- Diamond, R. M. (1998). *Designing & Assessing Courses & Curricula – A Practical Guide*. SF: Jossey Bass, Inc.
- Duffy, T. M. and Jonassen, D. H. (1991). Constructivism: New Implications for Instruction Technology. *Educational Technology*, 31(5), pp. 7-12.
- George, J. & Cowan, J. (1999). *A Handbook of Techniques for Formative Evaluation* (1<sup>st</sup> ed). London: Kogan Page Limited.
- Herrington, J., Reeves, T.C., Oliver, R., and Woo, Y. (2004). Designing authentic activities in web-based courses. *Journal of Computing and Higher Education*, 16 (1), 3-29.
- Hong, K. S., Lai, K. W. & Holton, D. (2003). Students' Satisfaction and Perceived Learning with a Web-based Course. *Educational Technology & Society*, Vol 6 (1), pp. 116-124.
- Jonassen, D. H. (1994). Thinking Technology: Towards A Constructivist Design Model. *Educational Technology*, April, pp. 34-37.
- Jonassen, D.H., Peck, K.L., and Wilson, B.G. (1998). *Learning With Technology: A Constructivist Perspective*. New Jersey: Merrill/Prentice Hall.
- Lee, C. S. (1999). Problem-solving in a Constructivist Environment. *Educational Technology & Society*, Vol 2(4), pp. 137-145.
- Lim, C. P., Khine, M.S., Hew, T., Wong, P., Shanti, D., & Lim, B. (2003). Exploring critical aspects of information technologies integration in Singapore schools. *Australian Journal of Educational Technology (AJET)*. Volume 19, No. 1, 1-24.

- Mat, J. (2000). Technology in the Malaysian Education System. e-learning 2000: Accelerating e-Learning Towards Higher Education Value. *Malaysian International Conference & Exhibition on Electronic Learning 2000, Kuala Lumpur, Malaysia* [Online], Available: <http://www.e-learning2000.com.my>
- Muijs, D. and Reynolds, D. (2005). *Effective Teaching: Evidence and Practice*. London: Sage Publications.
- Neo, T. K. (2003). Using multimedia in a constructivist learning environment in the Malaysian classroom. *Australian Journal of Educational Technology* [Online], 19(3), 293-310. Available: <http://www.ascilite.org.au/ajet/ajet19/neo.html> [2005, March 31].
- Neo, M. & Neo, T. K. (2001). Innovative teaching Using multimedia in a problem-based learning environment, *Educational Technology & Society*, Vol 4(4), pp. 19-31.
- Neo, M & Neo, T. K. (2003). Developing a student-centered learning environment in the Malaysian classroom – A multimedia learning experience. *Turkish Online Journal of Educational Technology (TOJET)* Vol. 2, Issue 1, Article 3, pp, 13-21.
- Neo, T.K. & Neo, M. (2004). Integrating multimedia into the Malaysian classroom: Engaging students in interactive learning. *Turkish Online Journal of Educational Technology (TOJET)* Vol. 3, Issue 3, Article 4, pp. 31-37.
- Piaget, J. (1952). *The origins of intelligence in children*. New York: International Universities Press.
- Roblyer, M.D. and Edwards, J. (2000). *Integrating Educational Technology into Teaching* (2nd Ed.). New Jersey: Prentice-Hall.
- Savery, J. R. & Duffy, T.M. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology*, September-October, pp 31-38.
- Siaw, I. S.C. (2000). Fostering self-directed learning readiness by way of intervention in business education. In *Proceedings at the 2nd Asia Pacific Conference on Problem -Based Learning: Education Across Disciplines*, December 4-7, Singapore.
- .....

- Suraya H. (2005). A Framework for Strategis Future E-Learning Applications to Support Sustainable Growth in the E-Learning Industry. In *Proceedings of the International Conference on Multimedia and ICTs in Education (m-ICTE2005)*, June 7-10, 2005, Caceres, Spain, pp 1-10.
- Tan, O.S. (2000). Thinking Skills, Creativity and Problem-Based Learning. In *Proceedings in conjunction with the 2nd Asia Pacific Conference on Problem-Based Learning: Education Across Disciplines*, December 4-7, Singapore, 47-55.
- Teo, R. and Wong, A. (2000). Does Problem Based Learning Create A Better Student: A Reflection? In *Proceedings at the 2nd Asia Pacific Conference on Problem-Based Learning: Education Across Disciplines*, December 4-7, Singapore.
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Winnips, K. and McLoughlin, C. (2001). Six WWW Based Learner Supports you can Build. In Montgomerie, C. & Viteli, J. (Eds.), *Proceedings of Ed-Media 2001: World Conference on Educational Multimedia and Hypermedia*, Tampere, Finland: AACE, 2062-2067.
- Wong, S. L., Kamariah, A. B., & Tang, S. H. (2003). Differences in Anxiety Between IT Competent And Incompetent Malaysian Pre-Service Teachers: Can a Discrete IT Course Taught in a Constructivist Learning Environment Solve This Problem? *Turkish Online Journal of Educational Technology (TOJET)*, Vol. 2 (4), <http://www.tojet.net/articles/244.htm>.

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