Exploring Students' Creativity and Design Skills through a Multimedia Project: A Constructivist approach in a Malaysian classroom

Assoc. Prof. Dr. Mai Neo and Assoc. Prof. Dr. Tse-Kian Neo. Multimedia University, Malaysia

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Abstract
Research has shown that students have graduated from institutions of higher learning with a lack of creativity and critical-thinking thinking skills. This mismatch in skills has resulted in a nationwide initiative in using technology in the classroom to create a learning environment that would stimulate students' creative and problem-solving process, and to cultivate an engaging and media-rich design learning process. In this paper, we explored the use of constructivist learning principles within a multimedia design course on students' creative and critical-thinking skills, via the design of a multimedia project. The project design and development required group collaboration and the enabling of students to document their design process throughout the trimester in webpages and project reports. The results of the study showed that student teams were able to create innovative and engaging applications and were able to document critical-thinking processes throughout their project development. Motivation, teamwork and collaboration, and increased understanding, were key components of this learning environment and multimedia technology was an enabler for them to become creative and critical in their thinking, thus increasing their engagement in the classroom. The constructivist learning principles used in the study also showed positive results as a pedagogical framework for creating engaging learning environments for students.

Key words
multimedia design, creativity, problem-solving, technology, constructivism, Malaysia

Introduction

Current research shows that many graduates today are ill-equipped with problem-solving and communication skills needed to meet the demands of the IT industries (Tan, Teo & Chye, 2009). Research shows that students need skills to plan and evaluate their learning activities and to synthesize the information they garner (Laurillard, 1993). Jonassen (1999) suggested that students would learn better through a constructivist learning environment and Herrington, Reeves, Oliver & Woo (2004) posit that these learning environments should be authentic and relevant to the student in order to better engage them. Roblyer & Edwards (2000) have also posited that technology integration strategies can generate motivation by capturing learners' interest and enthusiasm, increase transfer of knowledge to problem-solving by using highly visual environments, motivates learning and ease task accomplishment, and develop technological and visual literacy to provide practice in using modern methods of communicating information. With the advancements of technology today, the Malaysian Government has embarked on an initiative to incorporate technology into the classrooms, in the hope of moving away from traditional classroom teaching to creating more stimulating learning environments for both the teachers and the students (MOE, 2008) to equip students with crucial life skills. In doing so, institutions of higher learning here in Malaysia have also started meeting those challenges by integrating multimedia into various teaching and learning environments (Norhayati & Siew, 2004; Hong, Abang Ekhsan & Zaimuarifuddin, 2005; Lee & Tsai, 2005; Neo, Neo & Tan, 2011). Even so, traditional education is still being criticized for its inability to properly imbue creative thinking skills in graduates, which is of concern as creativity is gaining more importance as an essential skill for graduates to have when in the workplace (Tan, Chye & Teo, 2009)

Creativity, in this research, is broadly defined as *"…any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one"* (Csikszentmihalyi, 1996), and allows for creative achievement (Piffer, 2012). Multimedia has been shown to motivate learners to express their ideas creatively and display their information in various ways (Muller, Lee & Sharma, 2008; Hillis, 2008; Jusoh & Jusoh, 2009). When multimedia is used as an instructional platform, a student-centered learning environment can be created. This environment empowers the students to interact with the content and control the flow and navigation of the information and therefore, of their own learning process (Hillis, 2008). Multimedia technologies provide an effective platform and technological support as media-rich activities can be incorporated. For the teachers, technology would allow them to facilitate the students' learning processes and engage them in more innovative teaching materials and assignments. Jonassen, Carr & Yueh (1998) have suggested that technology can become a student's "intellectual partner" and help them analyse, synthesize and organize their knowledge and comprehension. For the students, using technology would provide them the affordances of becoming an author and designer of creative work, and consequently, involve them directly in their learning paths. In addition, the incorporation of

multimedia can be used to create learning activities in which students can interact with and explore, creating an environment for students to design and be creative (Muller, et. al, 2008; Hillis, 2008; Kim & Gilman, 2008), and thus, engage in learning by doing (DuFour, DuFour, Eaker & Many, 2010).

The Faculty of Creative Multimedia in the Multimedia University in Malaysia was created to produce creative content designers to fulfill the requirements and needs of the Malaysian IT and Creative industries. Students taking faculty subjects would be exposed to design and creative problems to create interactive and media rich artefacts. The objective of this research study was to map Cunningham, Duffy & Knuth's (1993) constructivist principles to the design process of a multimedia project to investigate students' creativity processes when tasked with collaborative work. In this learning environment, students would design and develop interactive, media-rich applications that would reflect their creativity and problem-solving design skills. The learning environment would seek to equip students with crucial skills like higher-order analysis, where they can embark on deep reflective thinking, where the content studied becomes so interesting to them that they are able to generate new thoughts, formulate new understanding and belief about it (Lunenberg, 2011) and to be able to analyse, synthesize and evaluate the information gathered in meaningful ways (Lambert & McCombs, 1998). In addition, students can develop effective complex communication skills, such as presentations to the class, keep their progress documented and updated, engaging in group discussions and decision-making, all of which would give them an upper hand when they assimilate themselves into the working world (Herrington & Kervin, 2007). Students would be solving complex real-world problems, completing tasks that mimic the tasks in an actual working environment and be engaged in challenging, collaborative type activities that motivates them (Herrington & Herrington, 2006). In addition, using a multimedia design project would create a problem-based design environment for the students who would then have to decide, as a group, the desired design and the best technology to use to create it. Some of the design issues that the groups had to deal with included group themes, re-designing the image, creating a web page and group website to describe their design process.

Designing with constructivist learning principles

Constructivist learning has emerged as the main channel in education arena through the work of Dewey (1896), Piaget (1952), Bruner (1985) and Vygotsky (1978), and set a benchmark for constructivist learning theory today. 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 (Buraphadeja & Kumnuanta, 2011; Wagner, 2010; Scheer, Noweski & Meinel 2012). In addition, advocates of constructivism agree that acquiring knowledge or knowing is an active process of constructing understanding rather than passive receipt of information, and Bruner (1985) has stated that, *"Learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge."* Constructivism concentrates on learning 'how to think and understand' rather than on rote memorization, and is well-suited to cultivate a higher level of student engagement.

Constructivist learning environments have been shown to be effective in cultivating learning capabilities such as teamwork and collaboration (Burdett, 2003) as it is *"a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities"* (Wilson 1995), and as such, these environments are ideal learning spaces for collaborative work to take place and develop a community of creative learners who support individual creative outputs (Csikszentmihalyi, 1999, John-Steiner, 2000). Schank, Berman & Macpherson (1999) added to this by stating that there would be better student learning through the learning objectives of project-based learning, which is an effective strategy in engaging students in design thinking (Neo et. al, 2011; Moalosi, Molokwane & Mothibedi, 2012). Likewise, advocates of constructivism agree that acquiring knowledge or knowing is an active process of constructing understanding rather than passive receipt of information and can lead to increased motivation levels especially when combined with technology (Jonassen 1999; Jusoh & Jusoh, 2009), and the work of John-Steiner (2000) furthers the social-constructivist notion that creativity can be further enhanced through collaboration and interactions. Constructivism entails a strong belief that learning is a personal interpretation of the world; and that learners create interpretations of the world based on their past and current experiences and interpretations (Jonassen 1999; Duffy & Cunningham, 1996; Cooperstein & Kocevar-Weidinger, 2004; Gordon, 2009; Wagner, 2010). During constructivist learning, the emphasis is on learning and on the student-centric learning environment. Students become active participants in their own learning processes and also learn to solve problems and work collaboratively. Cunningham, et. al (1993) proposed seven pedagogical goals that must be satisfied when creating a constructivist learning environment (CLE), such

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as the following:

1. Provide experience in the knowledge construction process, and anchoring all learning activities to a larger task or problem
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 implicit objective of this study was to develop graduates with independent learning, multimedia design and problem solving skills, good communication skills, together with responsibility to handle projects with co-workers. Consequently students can synthesize this learning concept when they work with authentic projects in the working industry. Therefore, as part of the facilitation process in this study, the teacher employed these constructivist learning principles to create a learning environment that would support their design process. In addition to this, multimedia technology was incorporated into the design activities as it has been shown to affect students' motivation and self-esteem levels, as well as allow them to be creative and self-directed thinkers.

Designing the learning environment

Students taking the Interactive Multimedia course offered by the faculty were tasked with an ill-structured problem to design an appealing application for the Malaysian Tourism Board highlighting Malaysian culture. Consistent with the constructivist learning position of creating an authentic setting for the students, the class was given an identity, "MMM2013 Inc", a multimedia solutions company, and the students took on roles of designers hired to execute several projects in different teams. Each team consisted of four to five members, they were given the freedom to choose their own team members as well as elect their team leader. All teams were required to come up with various interactive multimedia prototype applications for the CD-ROM delivery mode based on the class theme "Malaysian Culture".

The learning environment created supported the students in that they engaged in face-to-face lectures and online modules on multimedia principles and design foundations to gain prior knowledge on the subject. The critical component of the class was their multimedia project, where they would have to design and develop a working prototype application for submission at the end of 14-week trimester. In this study, the theme of the project "Malaysian Culture" and all student teams were required to develop their own interactive multimedia prototype based on this class theme. The students were required to create their project using Adobe Director, a leading authoring tool, which was taught in tutorials, and to present the final interactive multimedia application at the end of the trimester on a CD. This learning environment had several constructivist objectives:

1. Students were expected to become motivated and active learners and participate actively in their learning process, consistent with the characteristics of constructivist learning.

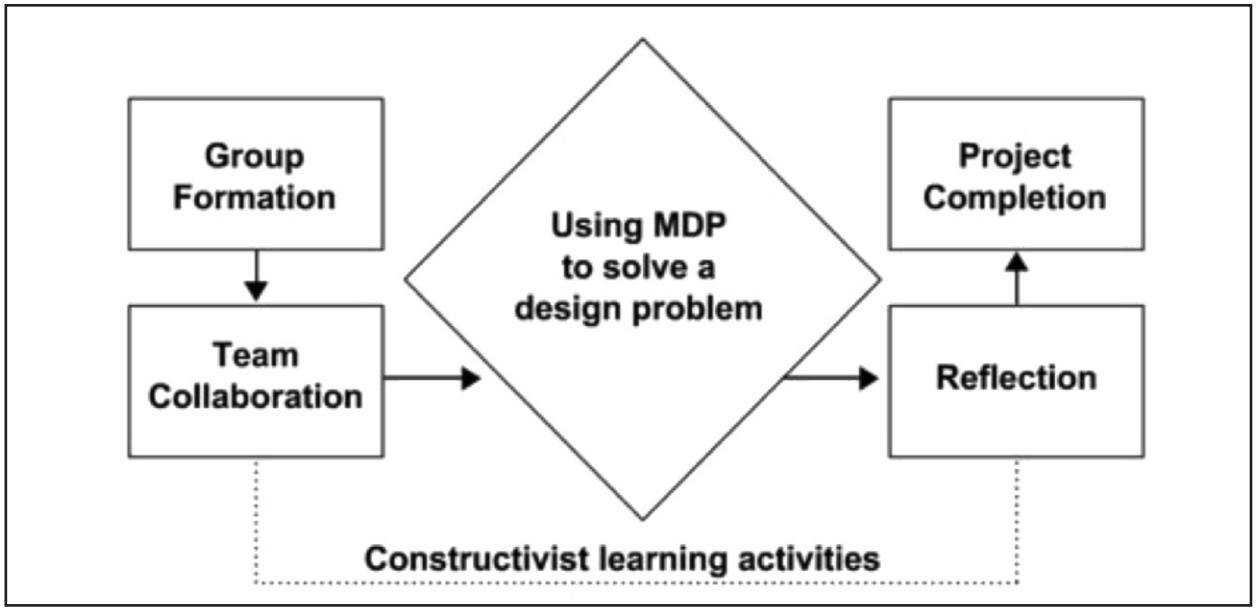

Figure 1 The student design process mapped to constructivist learning activities

2. Multimedia technology, via the multimedia project, was expected to be the catalyst for their learning.
3. Students would reflect and share their knowledge among other students; solve problems by own explorations; construct new knowledge from what was learnt from lectures; have good relationships and interactions with group members; as well as expose themselves to multimedia execution skills.
4. The learning environment setting was authentic and ill-structured problem was presented to the students to solve.
5. The project was to be a complex enough that students had to collaborate with each other in order to complete the project.

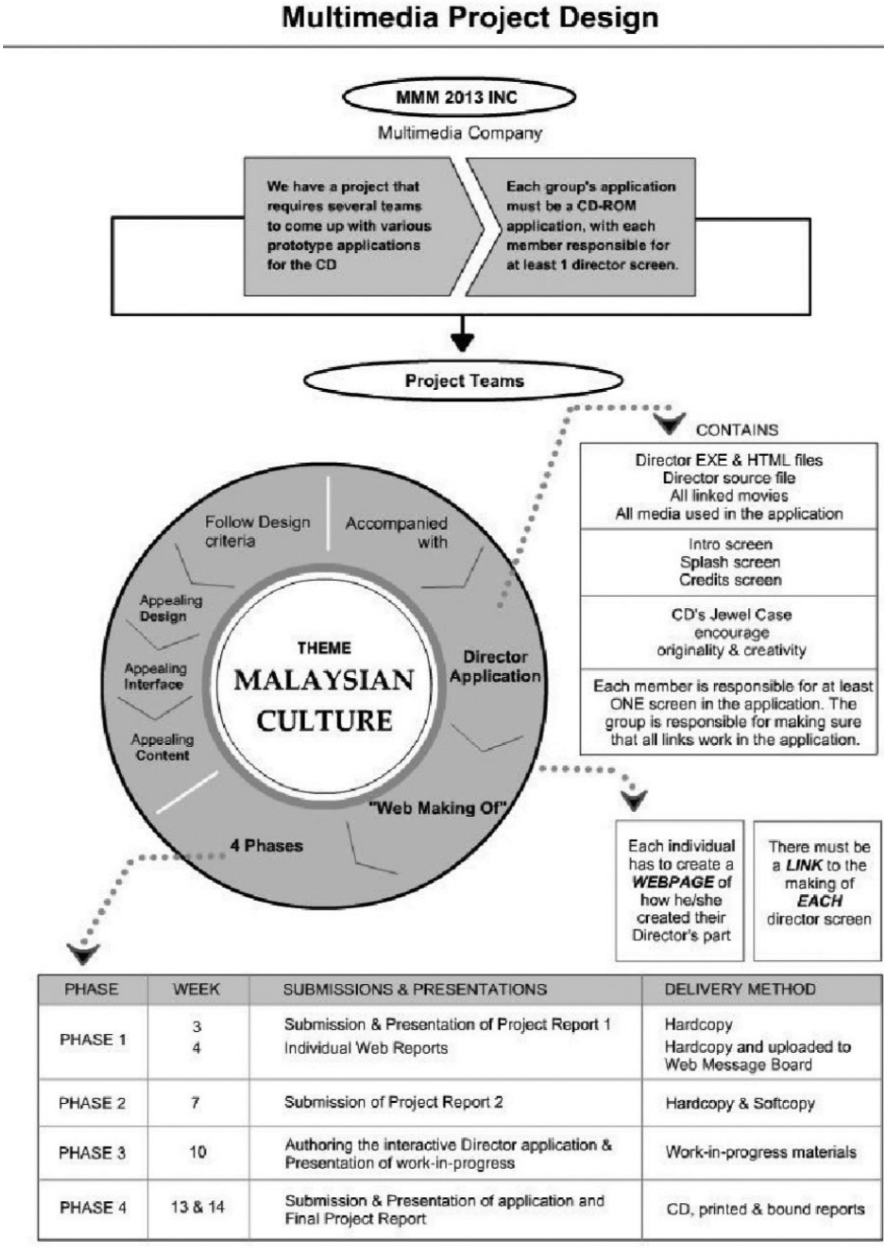

Figure 2 The multimedia design process

The project design mapped Cunningham et. al's (1993) constructivist tenets to a Multimedia Design Process (MDP) which were divided into 3 phases; 1) the Pre-authoring phase, where they would have to brainstorm about their chosen topic for the online magazine, make design decisions on the interfaces in the final product, and the media elements that were needed, 2) the Authoring phase, where student teams would proceed to transfer their analogue designs to digital designs using the Adobe Director, Flash, Dreamweaver, and Swish, and begin to create interactive features and links, and integrate all chosen media elements an all member pages, 3) the Post-authoring phase where they would finalise their work and create a distributable application. The student design process in this learning environment can be shown in Figure 1, and the multimedia design project's process is illustrated in Figure 2.

During the Pre-authoring phase, initial sketches/concepts for the proposed interfaces for the project were developed and discussed during the consultation times set up by the teacher during class times, to provide teams the opportunity to hold group meetings. Here the student teams were able to consult with the lecturer on technical and conceptual matters pertaining to their project, as well as carry out their group meetings. Teams also had to present their storyboard concept to the class for feedback and comments. Figure 3 and Figure 4 show the flowcharts of ideas for Team 1 and Team 4's proposed applications.

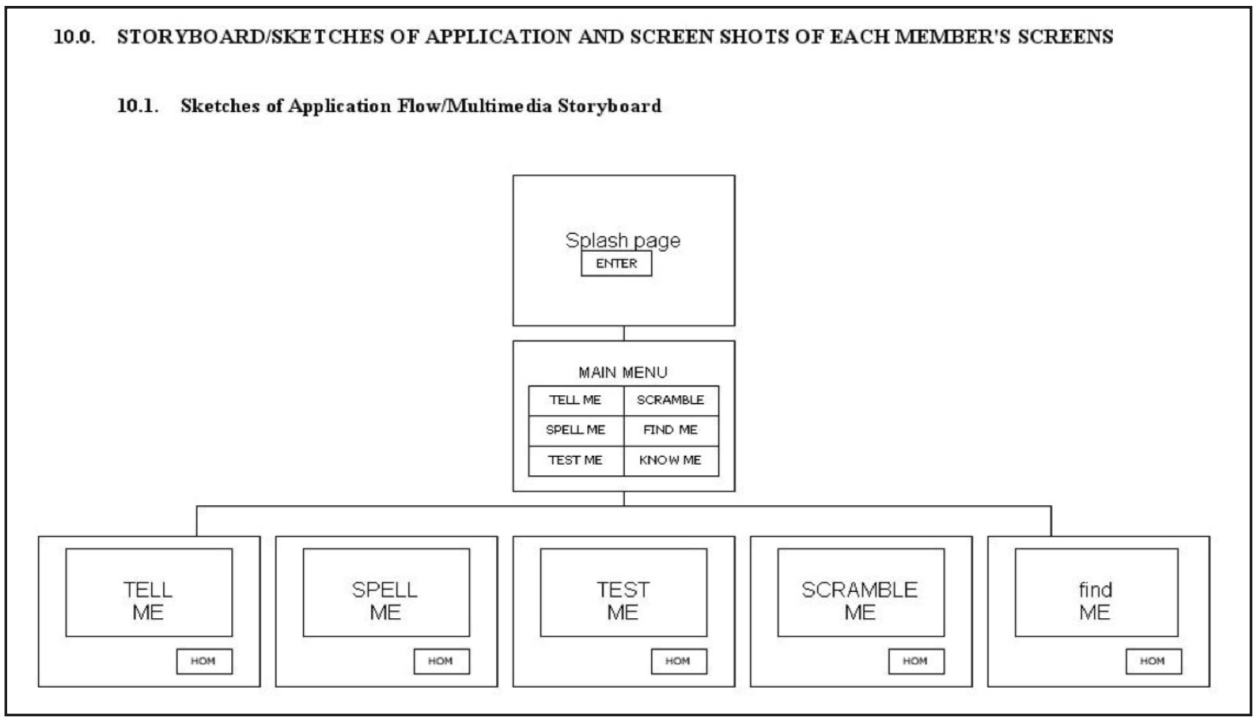

Figure 3 Storyboarding process of Team 1

Team 1 decided to create a storytelling application on "*Hang Tuah*", a legendary figure in Malaysian culture, as children's storybook and an edutainment application. As shown above, the team's creativity is shown in the flowchart of the application's Menu page, where the application would have several menu functions, designed to tell the story (TELL ME) and engage the user in learning activities such as a spelling bee (SPELL ME), a quiz (TEST ME), a word scrambler (SCRAMBLE ME) and a treasure hunt game (FIND ME). In contrast, Team 4's application centred around "*Malaysian Bad Habits*", a lighthearted look at some of the bad habits of Malaysian people. The interface proposed would be an image map, which would then lead to separate pages bad habits of Malaysians, such as queuing, language, cinema and road behaviours, and buying pirated optical media. In this phase, student groups begin to engage in collaborative activities and group negotiations. The opportunity to present design solutions that were varying in perspectives and reflected their own group choices was characteristic of constructivist learning which allowed for multiple perspectives to an ill-structured problem. Student groups begin to create ownership of their work and be in charge of their decision-making process.

Activities for the Authoring Phase started from Week 10. Here teams implemented their ideas and concepts which they presented during the storyboard stage in Phase 1 by developing the digital application on Adobe Director. Since creative outcomes involve the possibility of risk activity and risk management, as suggested by the double AND gate model (Barlex, 2011), peers and lecturers played important roles in supporting and managing the risks that these student groups were taking in order to be creative in

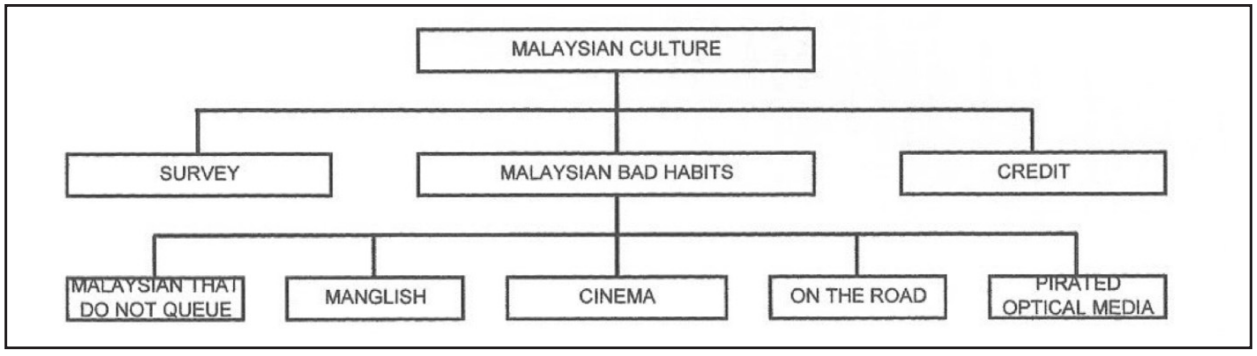

Figure 4 Storyboarding process of Team 4

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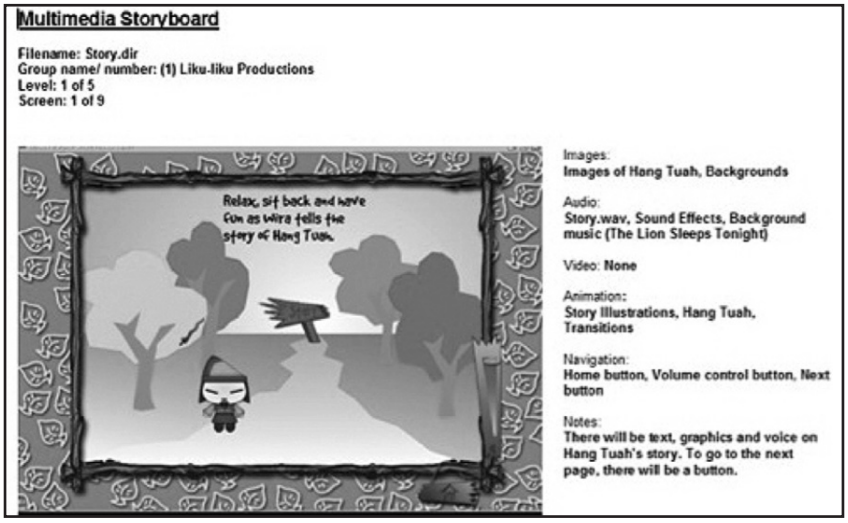

Figure 5 Team 1's sketch on Hang Tuah (created in Adobe Flash)

their design and outputs, especially during the Authoring phase, when synthesis and integration of media would be occurring. As part of facilitating and supporting this risk, the lecturers held consultation times during the class times and also by appointments, so as to formatively monitor student progress and provide ongoing feedback. Student teams were also required to present their work-in-progress in front of the class two times during the trimester, the first during the ideation stage, and the second a week before submission. All teams, including the lecturer, were given comment sheets to fill out and were required to evaluate the team presenting. The work-in-progress sheet contained the following items:

1. Comments on the concept of the application.
2. Comments on the use of multimedia.
3. Comments on the interface design.
4. Comments on the navigational structure of the application.

The feedback sheets were used to provide an opportunity for teams to reflect on their work. Students were encouraged to give constructive comments back to the other teams and evaluate them from both the developer's and the user's points of view. This would also give students the opportunity to gauge the effectiveness of their decisions made for the project by having other, non-team members evaluate their work, give some feedback on areas where to improve, as well as to solicit feedback on technical problems they may be facing. This would help reflect on the risks they were taking to "think outside of the box" and be creative, and how these risks were received by others. Figure 5 and 6 show the sketches that were created and presented by Team 1 and Team 4. Since the class was technology-based, and these were not design students, they had the option to create their sketches directly on the computer using illustration software (e.g., Adobe Flash), as was done by Team 1, or by hand, as for Team 4's sketches.

Finally, in the Post-authoring phase, student teams finalized their project for submission. In Week 15, the CD was submitted and subsequently evaluated by the lecturer. Figure 7 shows Team 1's finished application as per their flowchart in Figure 3, and Figure 8 shows the finished application of Team 8's as per their flowchart in Figure 4. In this phase, many of the key competencies of constructivism were called upon and supported as students were closer to the completion of their work. Strategic to this phase were students' abilities to remain involved in the work and to

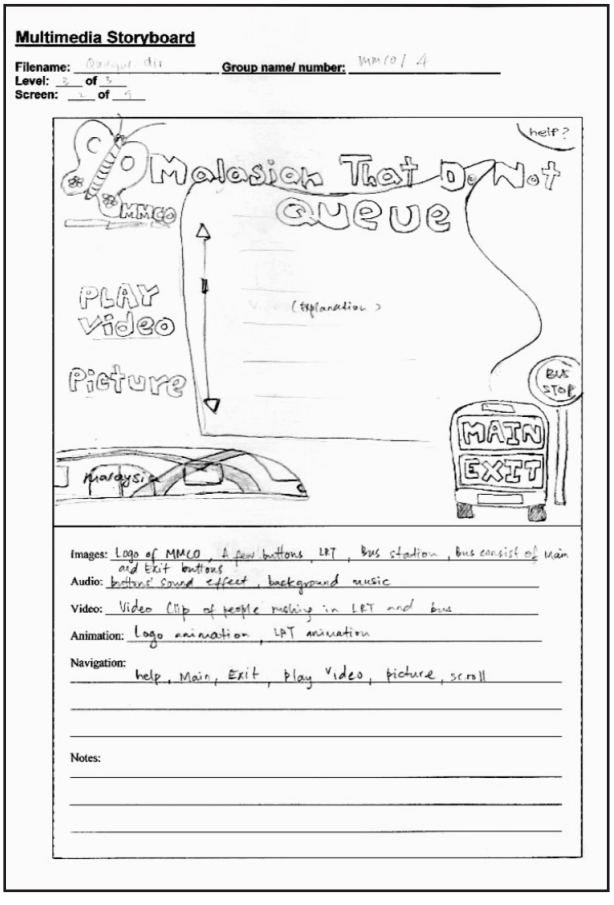

Figure 6 Team 4's hand-drawn sketch on Malaysian Bad Habits

Figure 7 Team 1's finished application

reflect upon their results in order to present the application orally at the end of the development period. This would be followed by their final report in their development process, for evaluation.

In addition, all teams had to document their progress both in a project report and in a webpage describing how they created their application, and what modifications they made based on feedback. In both these reports and webpages, students demonstrated not only their technical skills, but also their critical thinking and creative skills, so that every phase of their development process was captured and documented. Through this process, the student's creative design and multimedia development stages and thought processes would be presented. In addition, these reports and webpages were commented upon by the lecturer and their peers to provide a more social and distributed platform for student teams to exchange and collaborate on ideas. These feedback and comments would serve to help student teams reflect on their work and decide on their next procedures. These pages also helped in the evaluation of the students' design and development processes. Criteria for evaluation included the originality of the idea, the creative concept of the application, as defined by Csikszentmihalyi (1996), technical complexities, and the documentation of the process. Teams 1 and 4 scored well in the class as they showed creativity in the risk they took to present their chosen topics and to use multimedia tools well in creating an original application of the content. Other groups did not score because they chose to stay within the minimum guidelines of the project, presenting applications that were simple and linear in navigation, with no creative added value, or did not choose to improve after comments and suggestions were given.

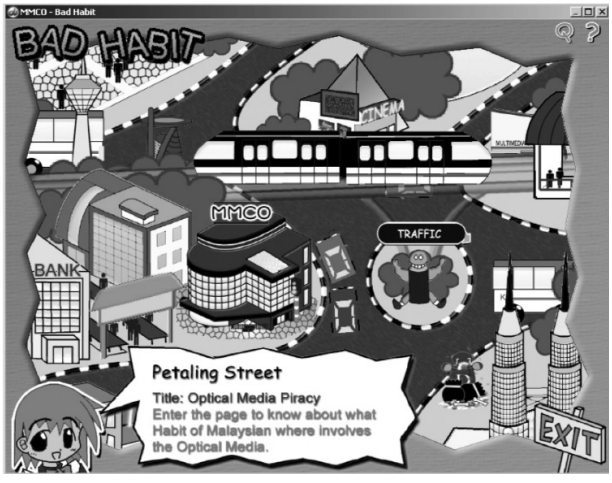

Figure 8 Team 4's finished application

Methodology

The study used a mixed-method research design and consisted of 53 (n=53) second-year students from the Faculty of Management (FOM) and the Faculty of Information Technology (FIT), pursuing their Bachelors of Multimedia (BMM) degree and enrolled in the Interactive Multimedia class, a course that combined both design skills and multimedia development. A set of questionnaires with 20 items, adapted from Neo & Neo (2001) and Diamond (1998), was created to gauge students' perceptions and attitudes towards constructivist learning experiences, such as increased motivation levels through active participation in the project (Jusoh & Jusoh, 2009; Herrington & Kervin, 2007), teamwork (Burdet, 2003), and improved learning (DuFour, DuFour, Eaker & Many, 2010; Wagner, 2010). The questionnaire responses were measured on a 5-point Likert scale, ranging from Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4) and Strongly Agree (5), to gauge their perceptions and comments on such a learning environment, and was

No	Items (N=53; Cronbach Alpha = 0.821)	Mean (m)	% (p)
1.	Challenging yet inspiring project	4.2	92.5
2.	Motivation to stay involved in project	4.0	83.0
3.	Able to apply skills	4.1	79.2
4.	Team solve problems in positive manner	4.0	83.0
5.	Capable of thinking critically	4.0	81.1
6.	Willing to make improvements to keep project growing	4.0	77.4
7.	Gained confidence	3.9	83.0
8.	Team resolved problems together	3.9	86.8
9.	Satisfaction with performance	3.8	69.8
10.	Able to manage group effectively	3.6	62.3

Table 1. Results of the questionnaire

administered to the students when they submitted their final project at the end of the trimester. In addition, open-ended questions were included on the questionnaire and interviews with student groups were conducted to solicit comments and feedback on the learning environment. These interviews were conducted at the end of the project and took about 30 minutes each with all members present. The interviews were recorded and the transcripts were analysed for comments that would provide insights to their experiences with the learning environment.

Analysis

Analysis using SPSS 16.0 yielded descriptive statistics shown in Table 1, and a Cronbach Alpha coefficient of 0.821, which satisfies the requirement for survey reliability (Lim, Khine, Hew, Wong, Shanti & Lim, 2003). Table 1 presents some of the means (m) for the items in the survey and the percentage of students (p) who responded positively (i.e., between 4 and 5 on the scale) on the learning environment. These results are further supported with interviews and student comments and presented in Table 2.

The results of the questionnaire yielded categories that were consistent with key constructivist learning competencies, motivation (Jusoh & Jusoh, 2009), teamwork (Burdet, 2003), and improved learning (DuFour, DuFour, Eaker & Many, 2010; Wagner, 2010). As shown in Table 1, students reported finding the project inspiring and a motivating factor to complete the task and were the two highest scoring items in the survey.

1. "I feel sometimes not motivated to go on, and when the group members have discussions, then I feel motivated again.
2. I feel satisfied and proud that our application came out great and this feeling encourages me to create better applications in the future."
3. "I feel very happy and satisfied with the result. It made me feel everything is worth it."
4. "I feel excited and happy for the successful completion of the project. I'm thankful also that all our hardwork paid off."
5. "I feel there is much more space for improvement and learning experience."
6. "I feel theory and technical always have to be in balance way to come out some well, and best applications."
7. "I feel that I had gained more knowledge and experience by doing the group assignments."
8. "I feel really glad to be in this group as we work together very well and my team mates really help each other when we have problems I feel very happy when work with my groupmates…I love my groupmates so much. :)"
9. "I feel interesting in this course because I can know other faculty friends and share the knowledge that I did not learn from my major…"
10. "…we do have some argument about the ideas but we had settle it with positive manner."
11. "I feel really glad to be in this group as we work together very well and my team mates really help each other when we have problems."
12. "We prefer working in team because we can share a lot of ideas from the members."

Table 2. Students' comments from open-ended questions in the survey

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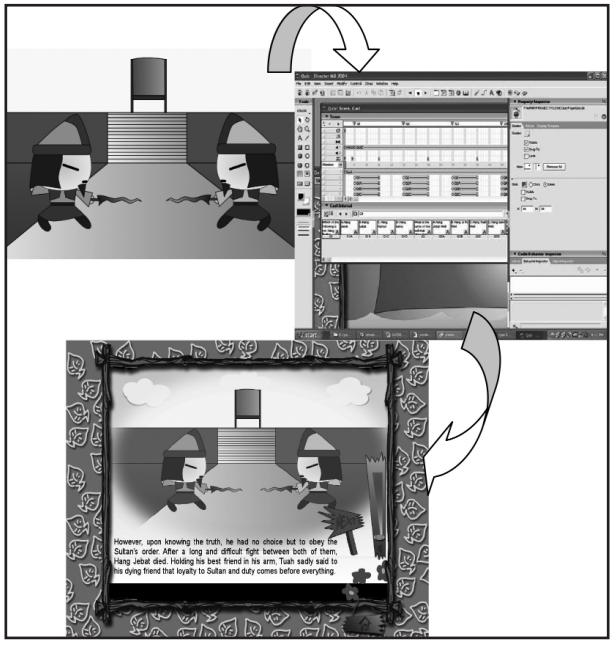

Figure 9 Team 1's creative design and development process, from sketches to authoring to final output

Motivation was a key component in this learning process. Students were motivated to achieve their learning goals and have self-efficacy and technology was an enabler for learning and engagement (Liu, Horton, Olmanson & Toprac, 2012) in the course. Learning and experiencing new skills, and applying them to the project, created confidence in students and increased their capabilities to think critically about their work. Teamwork played an important role in the learning process as students were able to work together in a positive manner and to collaborate to complete the project. As evidenced in the sketches and final design output (see Figure 9 and Figure 10) these student teams were successful in being creative in their learning processes.

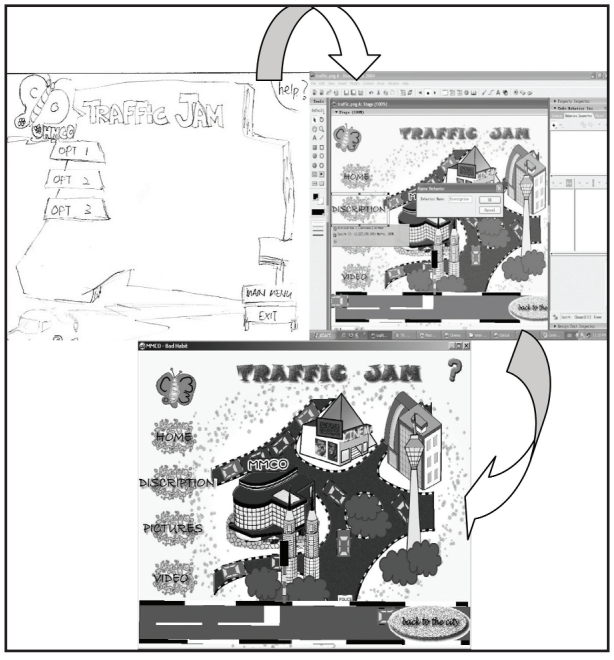

Figure 10 Team 4's creative design and development process, from sketches to authoring to final output

Throughout the design process, students demonstrated competencies in creative and critical thinking, from conceptualizing their ideas in sketches in the early phases to digitally articulating them in the authoring software and adding interactive features to complete the application, to further documenting their thought and development processes in their web pages. These competencies were consistent with constructivist learning of knowledge construction and active learning. Not only did they improve in their understanding of the content, but their learning process was embedded in a social community that was technologically-supported and collaboratively organised. The quantitative results of the study were well supported by the comments and interviews from the students who reported having varying levels of motivation during the 14-weeks, but finally feeling satisfied and happy when the application was completed. Again, teamwork and collaboration were positively viewed by students, who commented on the ability to share and help each other, all of which contributed to their positive perceptions of this study.

Conclusion

Cultivating students' design and creativity skills entails creating a learning environment that is conducive to exploration, inquiry, problem-solving, iterative modifications, and reflections, and that allows students to present ideas and concepts that reflect their personal choices and knowledge. Incorporating constructivist learning approaches to such a curriculum, in this study, created a learning environment that enabled students to experience such key competencies and prepare them better for real-world multimedia design and development demands. We can conclude that using a constructivist-based pedagogy such as Cunningham et.al (1993), embedded in a multimedia project design process was effective in motivating students to engage in their learning activities, create ownership of their work, be involved in all key decision-making events, and create a final application that best represented their interpretations of the design problem.

Multimedia technology was effective in being an enabler in the design process, allowing more access to creative representations, collaborative practices, and as an overall

motivator for students to see their analogue ideas transform into digital output. The teacher's role evolved to becoming a facilitator and guide for the students, and students themselves became the drivers of their learning paths. As such, this study was able to present encouraging support for Malaysian educators who are inclined to create technology-backed classrooms to improve students' creativity and multimedia design skills.

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neo.mai@mmu.edu.my

tkneo@mmu.edu.my