

Designing a CD based learning environment for a multimedia animation course: A Malaysian experience



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This paper focuses on the design and development of a CD-based learning environment which was based on the Nine Events of Instructions presented by Gagne (Gagne, Briggs, & Wagner, 1992). The learning module was then used as an instructional strategy to teach an animation course in the second year of the Film and Animation (FA) degree in the Faculty of Creative Multimedia (FCM). While this course has been traditionally given in a lecture-based environment, an attempt was made to move towards a more multimedia-mediated environment using the CD to provide a student-centred approach in learning the principles of animation. The aim of the study was to ascertain the attitudes and reactions of the students in this learning environment. Data were collected through a survey and questionnaire. A pre-test and post-test exercise was also administered to the students. Statistical analyses performed on the data showed that the students' attitudes and reactions were positive towards this student-centred environment and student learning was enhanced.

Introduction

In the last decade or so, the infusion of digital multimedia into teaching and learning has altered considerably the instructional strategies in the classroom. The passive teacher-centred learning approach has now shifted its focus towards encouraging students to actively participate in their learning process. Today, many learning institutions are finding new means to bridge the learning efficiency by using technology. Franklin and Peat (2001) stated that "Universities today are in transition. Much of the change we see is driven by economic pressures and demands for graduates who will be able to function in a knowledge society." This growing awareness amongst educators has thus resulted in their moving away from the traditional teaching and learning method to a student-centred approach through the use of technology (Damoense, 2003).

This changing trend has also influenced the educational instructional methodology in Malaysia. The Malaysian government is currently encouraging and emphasising the need to use technology and to incorporate multimedia into the existing educational curriculum (Mat, 2000). To show its firm commitment, the Malaysian Government has established the Multimedia Super Corridor (MSC) to link Malaysia electronically to the world community (Ghazali, 2000), and the Multimedia University (MMU) in 1996 in the MSC to provide education and training in multimedia technology so as to produce skilled workers for the knowledge-based industries in the country. This policy has provided a strong foundation to uplift the technological level of skills and methodology in teaching and learning in our schools, colleges and universities (Mat, 2000).

Though traditional face-to-face teaching method has its merits, it does not provide the skills necessary in today's fast-paced environment (Siaw, 2000). Students in such a learning environment are passive and do not have the opportunity to participate in their learning process. In this learning method, the teacher has total control over the content, structure and pace of the classroom. On the other hand, multimedia has been shown to stimulate and motivate students' interest and if used as a complementary source of information, it enhances learning (Jonassen, Peck and Wilson, 1999). Learning with computer and multimedia modules enables learners to interact with the learning module and the information presented. As such, research suggests that when such a learning interaction occurs, a learner's attention and comprehension of the learned subject increases (Brown, 2001). With an interactive multimedia learning module, students are able to navigate through the module and interact with the content at their own pace (Sims, 2000); thus, causing a fundamental change in learning from the traditional passive lectures to participating actively in student-centred learning activities.

Student centred learning environment

Gibbs (1992, p.2) defined student-centred learning as that which, “gives students greater autonomy and control over the choice of subject matter, learning methods and pace of study”. In other words, the learners can dictate their own learning relevant to their own approaches. Student-centred learning derived its meaning in a learning environment where knowledge is built and achieved by means of student’s active participation in the learning activities. Students do not passively listen and absorb the delivered information, but learn through a series of discovery, interaction, inquiry and problem-solving situations they actively engage in (Neo & Neo, 2004). In the student-centred learning mode, there is a need for students to assume a high level of responsibility in the learning situation and be actively choosing their goals and managing their learning process. They can no longer rely on the lecturer to tell them what, how, where and when to think” (Sparrow, Sparrow & Swan, 2000, p.2). Students should be able to actively choose programme components in whatever desired order, rather than simply work through a predetermined course of study (Andrewartha and Wilmot, 2001). If teachers were information keepers in a traditional classroom, in a student-centred concept, students are active information seekers. Therefore, researchers have defined student-centred as active learning, learning by “doing” rather than of passive watching or listening.

In order to design such an environment, interactivity is embedded into this learning environment. Ambron (1990) suggests, interactive learning is student-centred learning. In addition, interactive multimedia can be designed to allow users to access information according to their unique interests (Reeves, 1992). The most important goal for adding interactivity is to provide the learner with the choice to decide where to explore first within the application at his or her own pace. Liaw (2001) posits that hypermedia-based applications are non-linear and allows the learners to explore information in their own ways. While Kappe, Maurer and Sherbakov (1993) suggest that hypermedia is the force that puts all previous educational technologies in the shade. Laurillard (1993) agrees that hypertext is controllable by the user and this is the medium's real strength. As Lambert Gardiner (1993) argues, hypermedia feature in multimedia applications is educationally superior to traditional media because it simulates the real life situation of the students. Just as in the real life situation, students are dealing with information from many sources, with interactivity and hypermedia, learners are able to navigate through the application in a non-linear fashion and are able to view topics of interest directly rather than simply viewing a linear presentation. Thus, by allowing the students to explore the module on their own in a non-linear fashion, the students can learn in a student-centred environment.

Methodology

Designing the CD-based learning environment

The learning environment was designed and developed using based on Gagne’s Nine Events of Instructions. In his theory of instructions, Gagne has correlated the nine events of instruction with the associated internal mental processes and formulated these events as elements of a good lesson which promoted effective learning (Gagne, Briggs, & Wagner, 1992). Gagne’s theoretical framework was based on the cognitive perspective of learning and emphasised largely on the effectiveness of the instructional design. Hence, the development and creation of the CD-based learning environment in this research project incorporated Gagne’s Nine Events of Instructions (see Table 1).

Implementing the course

The course spanned across fourteen weeks. The initial course structure contained weekly lectures, one-on-one tutor discussions and critique sessions. However, to achieve the aims of this research project, CD-based learning was integrated as a substitute to the weekly chalk-talk lectures. Students were exposed to the CD method on the Principle of Arcs. This interactive multimedia environment was designed and developed using Adobe Flash as the principle authoring tool. Students were directed to learn the module independently in the lab, with tutor presence and facilitation provided. Forty one students participated in the study (n=41). All of them were students from the second year Film & Animation course of MMF 2013. The general age range was 19-24 years. These students had pre-requisites in design, multimedia and computer authoring subjects obtained from the first year course programme.

Table 1: Gagne's nine events of instructions as reflected in the CD-based learning environment

Event of Instructions	Features of the CD-based learning environment
Event 1: Gain attention	Images, textual information, sound and contrasting colours as background were used to draw and attract learner's attention. Animation was added as part and parcel of the course as well as to stimulate learners' attention.
Event 2: Inform learners of the objectives	A page stating and explaining the objectives of the module was included. Thus, the students were informed of the objectives prior to given the module. The title of the lesson was also stated which provided input to the content which, in this case, was the topic "Arcs." (see Figure 1). A pre-test was also given to the students prior to using the module.
Event 3: Stimulate recall of prerequisite learning	To learn the module, students needed to have prior knowledge in the multimedia and animation in general. Hence, they needed to know what multimedia and animation were in order to understand the topics given in the module.
Event 4: Presenting the content	Simple and clear language was used to present the content. The explanations were kept brief and to the point. In addition, the module presented a media-rich environment using images, sound, video and animation elements to illustrate ideas and demonstrate the content.
Event 5: Providing learning guidance	Examples, guided instructions, concepts, analogies, graphical representations and case studies were provided in the learning programme to give additional guidance to assist learning. Images, video, sound, and animation were also available for the students to use and understand the content being presented. Clear instructions were given to the students as well as directions to help students to explore and learn on their own.
Event 6: Eliciting the performance	A drawing board was created to provide the students with a learner activity. This activity was built into the module for the students to interact with (see Figure 2). Through the repetitive exploration of the learner's activity built into the module, the students will be required to demonstrate their understanding of the use of "Arcs" in the animation process.
Event 7: Providing feedback	Any responses from the students in the module were provided with immediate feedback and information; for example, the students were able to view an example of how the animation principle could be applied. Also, if the students had any questions regarding the content or the use of the module, the students could easily access the teacher in person to obtain feedback and guidance.
Event 8: Assessing performance	The students were also given a post-test to see if they understood the content that was presented to them. In addition, hands-on projects were also assigned to the students throughout the semester to assess if they were able to apply what they had learnt in a new situation. Also, the students were later assessed via critique sessions in front of a panel of lecturers and peers to demonstrate their understanding of the animation principles by creating an animation movie reflecting the principles learnt.
Event 9: Enhancing retention and transfer	The students had to apply what they had learnt in the module in doing a final independent project for the Animation degree. Students must exhibit the principles learnt to the actions in their animation. By applying the principles in their assignments they would show that they understood the principle and were able to transfer the skills learnt to a new situation.

Data collection and results

Survey and Questionnaire

A 5-point Likert scale and closed-ended questions were used as a tool for survey assessment. The survey containing 19-items was adapted from CAL Evaluation, Gregor Kennedy, University Of Melbourne (1998). The Likert scale used in this survey was from 1 to 5 (1=Strongly Disagree, 2= Disagree, 3=Undecided, 4=Agree and 5=Strongly Agree). The purpose of the survey was to ascertain the attitudes and reactions of the students on this learning environment. The CD-based survey was structured with the following areas - Motivation & Learning Objective, Content Organisation, Navigation & GUI and Multimedia & Interactivity. In addition to the survey, a set of open-ended questions was provided to enable the students to express their views.

Table 2 shows the mean (m), standard deviation (SD) as well as the percentage (%) of students who agree and strongly agree with the statements. The items in the results were divided in the four constructs as stated above. As for reliability of the survey, according to Lim, Khine, Hew, Wong, Shanti, and Lim (2003), a reliability of above 0.6 is deemed to have satisfied the reliability of the survey. The overall reliability of the survey questionnaire or the Cronbach's Alpha was 0.928. Thus, this survey is deemed

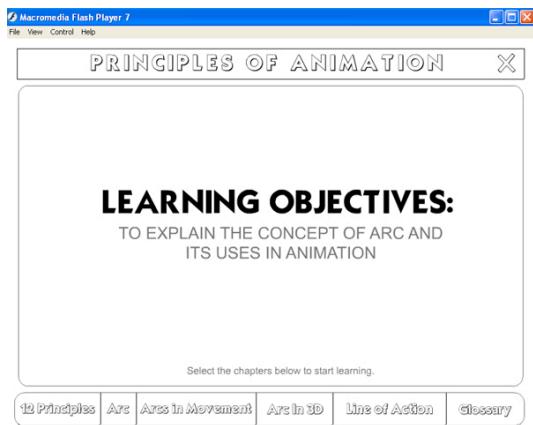


Figure 1: The title and objective of the module

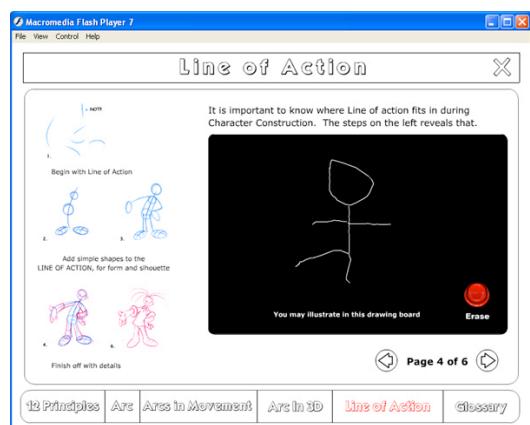


Figure 2: Learner's activity in the module

reliable. By looking at the survey items, the results were very positive. The means ranged from 3.78 to 4.68 with respondent rates ranging from 78.1% to 97.5% in agreement with the survey items.

From the results shown in Table 2, all the items under the motivation and learning objectives showed that the students were very motivated while learning in this environment and understood the learning objectives of this module as the mean scores were high, between 4.02 and 4.27. They found this learning strategy to be engaging and useful. They were clear on what they were learning and knew what the objectives of the subject matter were. They found learning in this manner improved their understanding of the subject matter. These findings were further validated from their feedback taken from the survey (see Table 3, under motivation) containing open-ended questions. The overall feeling from the students' feedback was that they enjoyed learning in this fashion and were motivated in this environment. Such comments from the students provided greater assurance that they were motivated in their learning.

When looking at the "Content" that was in the module (see Table 2), the results showed that all the items under this construct were also high. The means ranged from 3.90 to 4.27, signifying that the students strongly agreed there was the appropriate amount of information on screen and they could easily identify the key concepts and they found the organisation of the information clear and well-organised. To further strengthen the findings, the students' feedback was noted. According to the students feedback in Table 3, under "Content Structure", they found the information was written in simple and easy to understand English, focussing on the main points while keeping the concept clear and concise. This helps in their understanding and readability of the content.

As for the navigational structure as well as the graphical user interface (GUI) of the module, the results in Table 3 indicated that all the items had a mean score significantly greater 4, ranging from 4.05 to 4.34. This signified that the students had no problems navigating through the module on their own and were able to explore the content in the module by themselves. They also liked the interface of the module and knew where they were going to or where they had been in the module. The student feedback in Table 3, under "Navigation and GUI" also reinforces this finding as the students' feedback in the table indicated. They also stated that learning on their own pace was effective as they could go over the content again and again as long as they wanted. However, the navigational structure was good enough and they would not get lost in the module. As for the design of the GUI of the module, the results indicated that the students liked the design of the interface and found the graphics used "eye-catching".

When it came to the use of multimedia and interactivity in the module (see Table 2), the means of the items in this area were also very high. In fact, item 19 had a mean of 4.68 with 97.5% respondents, making it the highest scored item in the survey. The results showed that the role of multimedia in the module greatly enhanced the students' learning process and made the learning process fun. The use of graphics, video and text in the module allowed the students to visualise the content especially in the field of animation. The media elements such as video and animation clips provided the students with meaningful learning as they could see examples. With the use of interactivity and user interaction, students were able to interact with the content as well as participate in their learning process through the learner's activity which was built into the module to enable the students to practise their skills and to reinforce what they learnt. This feature found in the module was very conducive to their learning the content especially animation, as it provided them with an activity whereby the students could practise to draw what they understand of the the principles of using "Arcs" in animation. In addition, the student

feedback in Table 3, under “Multimedia and Interactivity”, provided greater insight to why they felt that way. The students repeatedly stated that the visualisation aspect of multimedia was very helpful in their learning process as it gave them a better understanding of the concepts presented to them

Table 2: The results of the survey given to the students

	CD-based learning	Mean	SD	%
	Motivation and learning objectives			
1	I find learning interesting and engaging.	4.07	0.721	82.9
2	I found the module useful for learning.	4.27	0.593	92.6
3	From the start it was clear what I was going to do in the module	4.02	0.821	78.1
4	From the start it was clear what the objectives of the module were	4.20	0.511	95.1
5	I know better about the subject after using the module.	4.05	0.740	85.4
	Content			
6	Generally there was just the right amount of information on each screen.	3.90	0.700	80.5
7	Important information or key concepts were easy to identify	4.22	0.652	87.8
8	Generally the content was clear and logically organised	4.27	0.501	97.6
	Navigation & GUI			
9	I found it easy to locate pieces of information I had previously used.	4.05	0.669	85.4
10	I found the interface clear, structured and appealing.	4.12	0.678	87.8
11	I always knew where to go next.	4.15	0.727	85.4
12	I found it easy to navigate my way around the module.	4.29	0.642	90.2
13	The buttons and links were easy to understand.	4.34	0.728	90.2
	Multimedia & interactivity			
14	I found the graphics and multimedia useful in visualising the concepts.	4.37	0.623	92.7
15	The module provided responses that were meaningful to me.	4.15	0.691	87.8
16	Multimedia increases my motivation to learn.	4.29	0.642	90.2
17	Interactivity helps me learn better.	4.39	0.703	92.7
18	The learner activity kept me actively engaged in learning.	3.78	0.936	70.7
19	Videos, movies and animations enhance my understanding.	4.68	0.521	97.5

Table 3: Students' feedback on the learning environment

(a) Motivation and learning objective
<ul style="list-style-type: none"> Motivated because it guides me through the subject without any other irrelevant subjects. I think it is way better than the conventional way of conveying a lecture. Enjoyable because can play around with the multimedia interactive. Fun interactive, easy to read and graphical example that easy to remember. I am motivated. If there were more examples, it would be better!
(b) Content Structure
<ul style="list-style-type: none"> In a way it's cool. Knowledge wise it is absorbable to the mind thanks to the simple language, brief but concise concept. Makes things or learning easier because the content is already summarised and highlighted. Simple English and the points were short and straight to the point. Yes I understand cause of the clear information and the graphic representation of the info. Easy to understand because it is already summarise and it is only focus on key point.
(c) Navigation and GUI
<ul style="list-style-type: none"> Was able to understand. Cause the content is shown out with simple navigation and design.. I like the text arranged well, navigation and user interface looks simple. Nice to see. I am able to learn using the CD module because it is interactive, full of information and I can go back and forth anytime I want. It give me control of my own learning It gives me time to read and understand because not everybody can pickup fast. Sometimes he or she has to read again and again to understand clearly.
(d) Multimedia and Interactivity
<ul style="list-style-type: none"> The idea of using MM elements is great! Rather than just showing plain text, it visualises the examples and really makes it easier for me to understand. All the key factors and main points were there. Visualisation through movies helps me a lot. Helpful. The videos and sketches make me understand more as it visualises the text. The interactive features give a sense of participation for the user. I personally like the part where I could draw on it. It's engaging and easy to remember. MM elements really meaningful to me. Because it visualise the movement of the action.

Analysis of learning scores

Besides soliciting the students' attitudes and feedback on the learning environment, the students were tested on the content. Pre- and post-tests were administered to assess the student learning of the content. Pre-test was taken at the start of the trimester prior to the commencement of the first lecture. This was followed with a post-test which was administered after the treatment to assess the knowledge transfer and the effectiveness of knowledge retention. Each test contained the same 15 multiple choice questions. The raw results of the pre and post tests are shown in Table 4. In the CD-based learning method, the students obtained a mean of 11.15 in post-test that was given after the use of the module. In the pre-test scores, an average mean of 6.29 was recorded. After the implementation of the module, the result showed an increase of 4.86 in post-test scores resulting in 32.4% of change in their tests scores.

Table 4: The means of the pre- and post-test of the students

Method	Number	Mean Pre-Test	Mean Post-Test	Mean Difference	% of Change
CD	41	6.29	11.15	4.86	32.4

Further analysis was performed on the results of the pre- and post-tests. A paired t-test was performed on this to ascertain the significance of the outcome. The results of the analysis are shown in Table 5, which shows that the difference in post-test and pre-test was very significant as $p=0.000$ at 95% confidence level ($p<0.05$). This indicates that the students learnt the material presented in the module. This further strengthened their survey results and their feedback pertaining to this learning environment.

Table 5: Results of a paired sampled t-test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test AniCD - Post-test AniCD	-4.854	3.175	.496	-5.856	-3.852	-9.790	40	.000

A test of normality of the distribution (see Table 6) was also performed. Since the Kolmogorov-Smirnov ($p=0.017$) is significant ($p<0.05$), therefore a non-parametric test or the Wilcoxon Signed Ranks Test is used to confirm the paired t-test. The result of the Wilcoxon Signed Ranks Test is shown Table 7. The test indicates that there is a significant difference in the means of the pre-test and post-test with $p=0.000$ ($p<0.05$). Therefore, confirming the paired-t test above. The results show a strong indication that the students increased their learning of the content in the CD-based learning environment. Moreover, to find the effect size, the mean difference (df) and the standard deviation (SD) in Table 5 were used. The effect size was calculated to be 1.53 ($4.854 / 3.175 = 1.53$), a strong indication that the students learnt the material in this CD-based environment. Thus, these results were strongly supported by the student survey, comments and the learning score above.

Table 6: Test of normality

Kolmogorov-Smirnov ^a			
	Statistic	df	Sig.
Difference score CD	.153	41	.017

a Lilliefors Significance Correction

Table 7: Wilcoxon signed ranks test

Ranks		Test statistics ^e			
		N	Mean Rank	Sum of Ranks	
Post-test AniCD - Pre-test AniCD	Negative Ranks	3 ^a	3.83	11.50	Z
	Positive Ranks	35 ^b	20.84	729.50	Asymp. Sig. (2-tailed)
	Ties	3 ^c			
	Total	41			

a Post-test AniCD < Pre-test AniCD

d Based on negative ranks.

b Post-test AniCD > Pre-test AniCD

e Wilcoxon Signed Ranks Test

c Post-test AniCD = Pre-test AniCD

Discussion

From the findings of this study, there are several important features that can be ascertained when the students were exposed to the CD-based learning environment. The following discussion presents some of the important aspects which influence greatly the student learning process.

The learning environment

In the CD-based method, the learning environment was student-centred. Unlike traditional lectures whereby the students remained passive and played little part in their learning process, in this environment, the students were actively participating in their learning process. They were able to explore and interact with the content in the module on their own. Also, they were able to interact with the built-in learner activity, allowing them to practise their drawing of "Arcs" which was an essential principle in learning animation. The results strongly indicated that the students enjoyed being able to do so and were more motivated in this environment rather than the traditional method of teaching.

Student-centred learning

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. Unlike the traditional method, the teacher dictated the pace of learning. In this environment, they were self-directed and were able to learn at their own pace. In the research findings, majority of the students expressed that they found this mode of learning enjoyable and fun. They did not have problems with the navigations and enjoyed using the navigational tools provided in the module.

Media-rich visualisation

In this learning environment, multimedia images such as graphics, animation and videos were used to present the instructional content. These helped the students visualise concepts and ideas. With animation and videos included in the module, students were able to see examples of how the principle of arcs was applied in an animated sequence. The results were highly supported in the surveys as well as the student feedback. The visualisation of the concepts enhanced their understanding of the content. They expressed strongly that those multimedia images in the learning module increased their motivation to learn and kept them actively engaged in their learning. Looking at the survey, the use of video and animation were rated the highest means by almost all the students who participated in this study.

Interactivity

Interactivity within the learning module had also an important impact on student learning as this feature provided the students with a navigation system in the module which enabled students to navigate around the module. This facility allowed students to determine their path of learning as well as the pace of learning. In other words, it allowed students to enjoy self-paced learning. These interactivity features were created and supported by means of multimedia authoring tools. In addition to navigational tools, the module's built-in learner activity provided the students the opportunity to interact and implement their learning of the concept of "Arcs". This enhanced their understanding and learning and engaged them in their learning process. They found it enjoyable, motivating and fun.

Clear and organised content

Part of the reason for the success of this module was the clear and concise organisation of the content in the module. The students were very clear of the objectives and knew how to navigate around in the module on their own without any problems. The results of the study together with the feedback from students clearly showed that the manner in which the content was organised suited the students. The English was simple and to the point and not wordy. This was important as students were learning by themselves for the very first time.

Autonomy in learning

This student-centred interactive learning mode provided students with many opportunities to manage their own learning process in the learning environment. Students could set their time and place of learning. They could also dictate the pace of learning as well as control the flow of information by using the interactive features provided by the learning instructions in the computer. In this mode, students learnt the content by interacting with the interactive multimedia instructional information in the computer. From the student surveys, interviews and feedback, it was evident that students liked their freedom in their learning process and found that this learning process was interesting and engaging, useful and increased their understanding of the subject domains.

Able to learn

From the results of the testing, it is very clear that the students managed to learn the content in the module and had fun doing so. This was shown in the paired t-test analysis which was significant and the effect size of the learning score which was also very strong. The increase in test scores, and results of the survey and student feedback, proved that this CD-based learning environment can serve as an effective instructional method in teaching and learning. The students were engaged and were motivated while learning the content in the module.

Presence of teacher

Although this learning environment was technology-based wherein the teacher's role was basically diminished, students found that the presence of the teacher in the lab useful and helpful to their learning whenever they needed assistance and guidance in their study. Hence, students still regarded the teacher as an important part of their learning process.

Conclusion

This study has successfully shown that students in this course enjoyed and felt motivated in their learning when CD-based learning environment 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. Thus, this technology-enhanced learning mode has a positive impact on student learning and can serve as an effective method to deliver instructions to learners.

References

Ambron, S. (1990). A short history of hypermedia. In J. Barker & R.N. Tucker (Eds.), *The interactive learning revolution: Multimedia in education and training*. New York: Nichols.

Andrewartha, G., & Wilmot, S. (2001). Can multimedia meet tertiary educational needs better than the conventional study? A case study. *Australian Journal of Educational Technology* 17(1), 1-20.
<http://www.ascilite.org.au/ajet/ajet17/andrewartha.html>

Brown R. (2001). Thinking in multimedia; Research-based tips on designing and using interactive multimedia curricula. *Extension Journal*, Volume 39(3).

Damoense, M.Y. (2003). Online learning: Implications for effective learning for higher education in South Africa. *Australian Journal of Educational Technology*, 19(1), 25-45.
<http://www.ascilite.org.au/ajet/ajet19/damoense.html>

Franklin, S., & Peat, M. (2001). Managing change: The use of mixed delivery modes to increase learning opportunities. *Australian Journal of Educational Technology* Vol. 17 Number 1, 37-49.
<https://doi.org/10.14742/ajet.1771>

Gagne, R., Briggs, L. & Wager, W. (1992). *Principles of instructional design*. Fort Worth, TX: Harcourt Brace Jovanovich.

GHAZALI, M. (2000), Critical Assessment of the MSC's Seven Flagship Applications: Utilization of Socratic Deep Questioning: Method. In Proceedings of the *International Conference: Education & ICT in the New Millennium*, Kuala Lumpur, Malaysia, October 27-28, 716-730.

Gibbs, G. (1992). *Assessing more students*. Oxford: Oxford Brookes University.

Jonassen, D.H., Peck, K.L., and Wilson, B.G. (1999). *Learning With Technology: A Constructivist Perspective*. New Jersey: Merrill/Prentice Hall.

Kappe, F., Maurer, H. and Sherbakov, N. (1993). Hyper-G: A universal hypermedia system. *Journal of Educational Multimedia and Hypermedia* 2(1), pp. 39-66.

Kennedy, G.E. (1998). *Computer aided learning: Formative evaluation questionnaires*. Biomedical Multimedia Unit, University of Melbourne.

Lambert Gardiner, W. (1993). Using hypermedia to turn university teaching inside out. In *Verbo-visual literacy: Understanding and applying new educational communication media technologies*. Selected Readings from a *Symposium of the International Visual Literacy Association*, N. Metallinos (Ed), June 25-29, pp. 65-72, Delphi, Greece.

Laurillard, D. (1993). *Rethinking university teaching: A framework for the effective use of educational technology*. London: Routledge, UK. <https://doi.org/10.4324/9781315012940>

Liaw, S.S. (2001). Designing the hypermedia-based learning environment. *International Journal of Instructional Media*, Vol. 28 (1), pp.43-56.

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*, 19(1), 1-24. <http://www.ascilite.org.au/ajet/ajet19/lim.html>

Mat, J. (2000). Technology in the Malaysian Education System, *Malaysian International Conference & Exhibition on Electronic Learning 2000*, Kuala Lumpur, Malaysia, May 25 2000.

Neo, T.K. & Neo, M. (2004). Classroom innovation: Engaging students in interactive multimedia learning. *The Campus-wide Information Systems (CWIS): The International Journal of Technology on Campus*, 21(3). <https://doi.org/10.1108/10650740410544018>

Reeves, T. C. (1992). Evaluating interactive multimedia. *Educational Technology* 32 (10), Oct, pp. 47-53.

Siaw, Irene S.C. (2000). Fostering self-directed learning readiness by way of intervention in business education. Proceedings at the *2nd Asia Pacific Conference on Problem-Based Learning: Education Across Disciplines*, Singapore, December 4-7, 2000.

Sims, R. (2000). An interactive conundrum: Constructs of interactivity and learning theory. *Australian Journal of Educational Technology* 16(1), 45-57. <http://www.ascilite.org.au/ajet16/sims.htm>

Sparrow, L., Sparrow, H. & Swan P. (2000). Student-centred learning: Is it possible. In A. Herrmann and M.M. Kulski (Eds), *Flexible Futures in Tertiary Teaching*. Proceedings of the *9th Annual Teaching Learning Forum*, 2-4 February 2000. Perth: Curtin University of Technology. [Online] Available: <http://lsn.curtin.edu.au/tlf/tlf2000/sparrow.html> [2006, 20th March].

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