Malaysian Online Journal of Instructional Technology (MOJIT) Vol. 3, No.1, pp 85-95
April 2006
ISSN 1823:1144

Learning "Goal Programming" Using an Interactive Multimedia Courseware: Design Factors and Students' Preferences

Baharuddin Aris, Maizah Hura Ahmad, Kok Boon Shiong, Mohamad Bilal Ali, Jamalludin Harun & Zaidatun Tasir
Department of Educational Multimedia
Faculty of Education
Universiti Teknologi Malaysia
Skudai, 81310, Johor, Malaysia

Abstract

This paper attempts to describe a research project related to the learning of "Goal Programming" of Form Six students, using an interactive multimedia (IMM) courseware. The purpose of the study was to determine the suitability of the design in the multimedia courseware for the learning and students' preferences toward the use of the courseware compared to traditional methods of learning the topic. The treatment instrument, that is the IMM courseware, was developed by a team of experts at the Department of Educational Multimedia, Faculty of Education (multimedia courseware design and development) and the Department of Mathematics, Faculty of Science (content expert) at Universiti Teknologi Malaysia (UTM). The research instrument was in the form of a questionnaire that consisted of six main parts. Out of 114 of Year One science students, 16 students participated in the pilot study while another 40 students volunteered to participate in the actual study. Results from the analysis showed that many students agreed that this IMM courseware is user-friendly and able to support the learning of "Goal Programming". Many students also prefer learning it using an IMM courseware compared to traditional methods of learning while teachers play the role of a facilitator.

INTRODUCTION

With the rapid advancement of interactive multimedia (IMM) courseware in the form of stand-alone CDs/DVDs and the web, students has been provided with exciting new sources of information and entertainment and thus a new meaning to education, that is, "edutainment". Our students are able to interact with the content in a particular curriculum using the IMM courseware. The establishment of Smart Schools across Malaysia has activated a demand for more locally produced educational multimedia courseware. Foreign educational multimedia courseware, which was once used without much thought given to its relevance and impact, is now considered not quite appropriate for the Malaysian educational environment and learning needs.

Rationale of the Research Study

Why did we conduct this research study? In the syllabus for the year 2002, the topic of "Goal Programming" of Mathematics S (Sastera/Arts) was listed and this was chosen for the research study.

In the Sinaran Institute, Kota Kinabalu, Sabah, students of Year One science and intensive science can register for Mathematics S as an elective for the STPM (Sijil Tinggi Pelajaran Malaysia) examination. Students from the commerce or literature stream can also take Mathematics S as an elective subject. All students who register for this subject are required to attend classes. Based on

formal interviews with students at the end of the year 2002, "Goal Programming" was one of the topics that students found to be relatively difficult.

Not all schools which offer Form Six classes around Kota Kinabalu, Sabah, offer Mathematics S to the students. The main reason is the lack of teachers who are capable of teaching Mathematics S. Consequently, those students who are interested and registered for this subject have to study it on their own. The question therefore arises as to whether a particular interactive multimedia (IMM) courseware in the form of a CD-ROM would be accepted by the students as an alternative delivery method to support their learning of Mathematics S, particularly the topic of "Goal Programming".

The Instructional Design Model

Why did we choose the ADDIE model for this research study? Although there are many different types of instructional design models, one model that has been widely adopted is the instructional systems development (ISD) model. This model is based on the systems approach. Molenda et al. (1996) placed the highest value on the following qualities of the model:

- It is systematic (the steps are carefully prescribed and follow a logical order).
- It is systemic (the steps are intended to cover all processes critical for success; the designer is constantly aware of the interdependence of the elements of the total instructional system (learners, instructors, materials, environments).
- It is reliable (the steps are spelt out in sufficient detail so that the intellectual processes can be carried out with great similarity from one designer to another, one project to another and over time).
- It is iterative (the cycle of analysis-design-development-testing-revision will be repeated a number of times during any given project).
- It is empirical (data gathering is built into the process and decisions are made on the basis of data).

The main elements of the instructional systems development model are analysis, design, development, implementation and evaluation. Thus, this model is commonly referred to as the ADDIE model. The ADDIE model has been widely used as a step-by-step procedural blueprint for the whole process of multimedia production (Molenda et al., 1996). For example, Barrese et al. (1992) used such an approach to design, produce and evaluate the CAMCE (Computer-Aided Multimedia Courseware Engineering) project funded within the DELTA (Developing European Learning through Technological Advance) European Community Programme. The approach proved extremely useful.

Analysis of Learning Styles

What is or are the dominant learning style(s) of students? Students often use different learning styles in studying, operating either as an activist, a theorist, a pragmatist or a reflector (Baharuddin Aris, 1999). Knowledge of their preferred learning styles in any given situation thus needs to be determined to ensure the use of appropriate learning methods. Learning methods that provide for a variety of learning styles will help towards achieving this goal, since they will automatically cater for different types of learners. Knox (1977) stated that efforts to change attitudes and modify the affective domain are more likely to be successful if learning methods take into account different learning styles.

There are numerous learning style inventories that can be used to classify people (Molenda et al., 1996). The Honey and Mumford Learning Style Inventory, for example, consists of a set of 80 short statements for users to match themselves to certain learning style profiles.

The Honey and Mumford Learning Style Inventory was administered to 114 students from the Year One science class in the Sinaran Institute. Out of these students, 88 were reflectors, 11 pragmatists, 8 theorists and 7 activists.

Content Selection

What is "Linear Programming"? "Linear Programming" is an effective technique for solving problems that involve a single objective. However, most decision problems involve multiple objectives and often, conflicting ones.

What is "Goal Programming"? A number of techniques has been proposed for multiple-objective decision making. One of the most promising techniques for multiple objective decision analysis is "Goal Programming". This is a powerful tool which draws upon the highly developed and tested technique of "Linear Programming" but it also provides a simultaneous solution to a complex system of competing objectives. "Goal Programming" can handle decision problems having a single goal with multiple sub-goals.

Generally, many decision problems in organisations involve multiple objectives. Such problems are not simple to analyse by optimisation techniques such as linear programming. Multiple-criteria decision making (MCDM) or multiple-objective decision making (MODM) has been a popular topic of management science during the past decade. A number of different approaches of MCDM or MODM has been proposed, such as the multi-attribute utility theory, the multiple-objective "Linear Programming", "Goal Programming", "Compromised Programming" and various heuristics. Among these, "Goal Programming" has been the best widely accepted and applied technique.

The primary reason for the wide popularity of "Goal Programming" appears to be its underlying philosophy of "satisficing". This "satisficing" rather than optimising approach which is based on the concept of bounded rationality, has emerged as a pragmatic methodology of decision making.

Why did we choose "Goal Programming" as the content in an IMM courseware? "Goal Programming" was chosen as an initiative to integrate the use of an IMM courseware into the existing teaching programme and to determine whether students would be motivated to learn a topic normally found to be relatively difficult. Baharuddin Aris (1999) found out that by using multimedia courseware, there is more learner control, students are motivated and are engaged in learning. This is because they can construct their own individual paths through the IMM courseware, control the pace at which they work and decide for themselves how much coaching or "scaffolding" they need.

Interactive Multimedia (IMM) Courseware – Basis for Selection

Why did we use an IMM courseware for the learning of "Goal Programming"? There were various reasons, the basic one being that the courseware is attractive, dynamic, interactive and effective, since it can combine still and moving pictures, and audio with text graphics. If computer-based learning material is chosen to assist with individual student problems, it must be interactive, probing to find where the student needs help and providing that help (Bork, 1997). With the enhancement

of multimedia elements, an IMM courseware can thus stimulate the student's mind and encourage learning through all senses.

In the new millennium, many research and development projects have been conducted related to learning mathematics using IMM courseware in Malaysia (for example, Zaleha Ismail, Zaidatun Tasir and Tan Wee Chuen). Sander et al. (2003), however, suggested that more research activities should be done to prove the impact of educational courseware on teaching and learning.

Computers have become an influence that not only shapes our daily life but also shapes our curricula in formal educational settings. Avouris (2001) highlighted that computer-assisted learning can help us deliver a deep and solid education to a specific subject. Conventional teaching methods are very familiar to all the students, and most are comfortable with them. The move to an IMM courseware has the potential to alter this comfort level. Therefore, this courseware must also be appealing to the students.

Interactive Multimedia (IMM) Courseware Design and Development

Zemke and Zemke (1995) advised courseware designers and developers, where possible, to take into account learning style differences because these differences do exist. Time, manpower and effort are among the requirements in producing and providing separate packages for each learning style, and they are the obstacles to good intentions. The collected data showed that most of the students (88 out of 114) were reflectors. Thus, the decision was taken to cater for a reflector style of learning.

The IMM courseware was developed by a multimedia design and development team at the Department of Educational Multimedia, Faculty of Education and a content expert at the Department of Mathematics, Faculty of Science at Universiti Teknologi Malaysia (UTM), (see Appendix A). Among the software components used for the development of the IMM courseware were Macromedia Authorware, Macromedia Flash, Microsoft Equation, Lotus ScreenCam and Camtasia Studio. A few screen shots from the IMM courseware are illustrated in Appendix B (see Diagram 1, Diagram 2, Diagram 3 and Diagram 4).

To produce an instructionally-sound IMM courseware package, researchers should always carry out formative evaluation of the product, or even ongoing evaluation at its different stages from prototype to final version. This prototype multimedia courseware was checked throughout the stages of design and development so that errors could be detected.

One of the main purposes of this formative evaluation was to check the basic organisation of the content and how best it could be delivered by this IMM courseware. A lecturer who had been teaching mathematics in this related topic for more than five years was chosen to look at the basic organisation of the content. The courseware was also tested related to its design, development and proper running before summative evaluation was conducted. Its design, development and proper operation were evaluated by two multimedia experts and 10 students. These 10 students were reflectors and not part of the actual study.

RESEARCH METHODOLOGY

Purpose of the Study

The purpose of the study was to determine the suitability of the design of the multimedia courseware for the learning of "Goal Programming" and students' preferences toward the use of an interactive multimedia courseware compared to traditional methods of learning "Goal Programming".

Research Design

This research and development project was descriptive in nature and adopted a quantitative method. Since the study was not concerned about improvements in students' performance before and after using a particular IMM courseware, an experimental research design was not enforced in the study.

Treatment Instrument

The treatment instrument, that is, the IMM courseware, was developed by a team of experts at the Department of Educational Multimedia, Faculty of Education (multimedia courseware design and development) and the Department of Mathematics, Faculty of Science (content expert) at Universiti Teknologi Malaysia (UTM) under the supervision of Associate Professor Dr. Baharuddin Aris.

Research Instrument

The research instrument consisted of a questionnaire. All the items in the instrument were carefully constructed so as to be in line with the purpose of the study. They were divided into six parts, namely, content, interactivity, navigation, feedback, screen design and students' preference toward the use of an interactive multimedia courseware compared to traditional methods of learning "Goal Programming". The Likert scale was used in the questionnaire, namely, 1 as Strongly Disagree, 2 as Disagree, 3 as Somewhat Agree, 4 as Agree and 5 as Strongly Agree.

Sample of the Study

The respondents consisted of Year One science class studying in the Sinaran Institute, Kota Kinabalu, Sabah. Out of the 88 reflectors who were in Year One science, 10 students were involved in the formative evaluation and 16 students participated in the pilot study. These 26 students were not included in the actual study. Another 40 students participated in the actual study.

Pilot Study

The questionnaire was validated by three teachers (each with five years' working experience). The 16 students who participated in the pilot study were also administered a similar questionnaire. Following the pilot study, a few items in the questionnaire were changed.

Reliability testing was also conducted. Part I of the questionnaire was related to the content of the IMM courseware. This part consisted of 14 items and the Cronbach's coefficient alpha (α) was 0.84. Part II of the questionnaire was related to interactivity. This part consisted of six items and the Cronbach's coefficient alpha (α) was 0.79. There were 12 items in Part III of the questionnaire that was related to navigation. The Cronbach's coefficient alpha (α) was 0.85. Part IV in the questionnaire was related to feedback and consisted of six items. The Cronbach's coefficient alpha (α) was 0.70. Part V in the questionnaire was related to the screen design of the IMM courseware and consisted of 18 items with the Cronbach's coefficient alpha (α) at 0.88. Part VI included students' preferences toward the use of an interactive multimedia courseware compared to

traditional methods of learning "Goal Programming". This part consisted of seven items with the Cronbach's coefficient alpha (α) at 0.72.

The Actual Study

Only 40 students participated in the actual study. Although more students were encouraged to participate in it, they were not able to so due to the tight schedule of lectures in the Sinaran Institute. Since the study was not concerned about improvements in students' performance before and after using a particular IMM courseware, no control or experimental group was assigned. Therefore, all 40 students were given the same treatment instrument (IMM courseware). No time limit was imposed upon them. Overall, the computer-based learning session took about two hours. These students were later distributed a questionnaire and again, no time limit was imposed on their response.

RESULTS

Table 1 shows the analysis on the content in the IMM courseware

Table 1: Analysis on the Content in the IMM Courseware

No	Item Questions	Mean	S.D
1.	The content is reliable.	3.43	0.78
2.	Correct use of grammar.	3.75	0.81
3.	Current and error-free information.	3.53	0.64
4.	Concepts and vocabulary relevant to learners' abilities.	3.43	0.84
5.	Information relevant to age group curriculum.	3.48	0.99
6.	Information of sufficient scope and depth.	3.25	0.87
7.	Logical progression of topics.	3.50	0.82
8.	Variety of activities, with options for increasing complexity.	3.50	0.85
9.	The content is structured in a clear and understandable manner.	3.35	0.92
10.	The structure allows learners to move around freely in different units.	4.13	0.72
11.	The structure of the multimedia courseware permits learners to advance, review, see examples, repeat the unit or escape to explore another unit.	4.23	0.86

Table 1 shows that the mean ranged from 3.25 to 4.23. Item 11 possessed the highest mean value whereas the mean value for item number 6 was 3.25, the lowest among the items.

Table 2 shows the analysis of the interactivity of the IMM courseware.

Table 2: Analysis on the Interactivity of the IMM Courseware

No	Item Questions	Mean	S.D
12.	The interactivity of this multimedia courseware is according to the maturity of the students.	3.60	1.03
13.	This multimedia courseware provides opportunities for interaction with standardised icons.	3.35	0.80
14.	The content is divided into small segments and includes formulas, examples and summaries for each segment.	3.60	0.87
15.	This multimedia courseware frequently poses questions to the users that do not interrupt the learning process.	3.43	0.68
16.	This multimedia courseware asks students to apply what they have learnt rather than memorise it.	3.70	0.85
17.	This multimedia courseware allows learners to discover information through active exploration.	3.55	0.85

Based on Table 2, the mean ranged from 3.35 to 3.70. Item 16 possessed the highest mean value of 3.70, whereas the lowest mean value for item number 13 was 3.35, which was the lowest among the items.

Table 3 shows the analysis of the navigation of the multimedia courseware.

Table 3: Analysis on the Navigation of the IMM Courseware

No	Item Questions	Mean	S.D
18.	Help key to get procedural information.	3.75	1.06
19.	Answer key to answer a question.	3.80	1.04
20.	Glossary key to see the definition of any term.	3.25	1.08
21.	Objective key to review course objectives.	3.53	0.82
22.	Content map key to see a list of options available.	3.75	0.81
23.	Summary and review key to review the entire lesson or parts of it.	3.45	0.93
24.	Menu key to return to the main page.	4.10	0.63
25.	Exit key to exit from the programme.	3.80	0.99
26.	Comment key to record a learner's comments.	3.33	0.97
27.	Example key to see examples of an idea.	3.60	0.98
28.	Key for moving forward or backward in a lesson.	4.08	0.73
29.	Key for accessing the next lesson in a sequence.	4.00	0.78

Table 3 shows that the mean ranged from 3.25 to 4.10. Item 24 possessed the highest mean value while the mean value for item number 20 was the lowest at 3.25.

Table 4 shows the analysis of the feedback of the IMM courseware.

Table 4: Analysis on the Feedback of the IMM Courseware

No	Item Questions	Mean	S.D
30.	This multimedia courseware provides feedback immediately after a response.	3.55	0.82
31.	The placement of feedback is varied according to the level of objectives.	3.48	0.91
32.	This multimedia courseware provides feedback to verify the correctness of a response.	3.53	0.72
33.	For incorrect responses, information is given to the student about how to correct their answers or hints to try again.	3.23	0.97
34.	This multimedia courseware allows students to print out their feedback.	3.30	0.94
35.	This multimedia courseware allows students to check their performance.	3.53	1.04

Table 4 shows that the mean ranged from 3.23 to 3.55. Item 30 possessed the highest mean value while the mean value for item number 33 was lowest at 3.23..

Table 5 shows the analysis of the screen design of the IMM courseware.

Table 5: Analysis on the Screen Design of the IMM Courseware

No	Item Questions	Mean	S.D
36.	Screens designed in a clear and understandable manner.	3.70	0.99
37.	The presentation of information can captivate the attention of students.	3.10	1.081
38.	The presentation of information can stimulate recall.	3.38	0.84
39.	The use of space is according to the principles of screen design.	3.63	0.87
40.	The design uses proper fonts in terms of style and size.	3.45	0.93
41.	The use of text follows the principles of readability.	3.53	0.96
42.	The colour of the text follows the principles of readability.	3.63	0.90
43.	The number of colours in each screen is no more than six.	3.75	0.95

44.	There is consistency in the functional use of colours.	3.60	0.93
45.	The quality of the text, images, graphics and video is good.	3.10	1.13
46.	Presented pictures are relevant to the information included in the text.	3.55	1.01
47.	The use of graphics meaningfully supports the text provided.	3.33	1.12
48.	A high contrast between graphics and background is retained.	3.48	0.88
49.	There is only one moving image.	3.15	0.89
50.	The video enhances the presentation of information.	3.35	1.10
51.	The sound is of good quality and enhances the presentation of information.	3.33	1.16
52.	The sound is an alternative means of presenting information and not a necessity.	2.85	1.19
53.	The integration of presentation means is well coordinated.	3.70	0.76

Table 5 shows that the mean ranged from 2.85 to 3.75. Item 43 possessed the highest mean value while the mean value for item number 52 was lowest at 2.85.

Table 6 shows the analysis on students' preferences toward the use of an IMM courseware compared to traditional methods of learning "Goal Programming".

Table 6: Analysis On Students' Preferences Toward the Use of an IMM Courseware Compared to Traditional Methods of Learning "Goal Programming"

No	Item Questions	Mean	S.D
54.	I prefer to learn mathematics with textbooks than via an interactive multimedia courseware.	2.45	0.96
55.	I prefer to learn mathematics with an interactive multimedia courseware instead of using textbooks.	3.28	0.98
56.	Learning mathematics with an interactive multimedia courseware that provides challenging quizzes and activities is more preferable than using textbooks.	3.93	0.75
57.	The activities provided in this interactive multimedia courseware are more effective compared to classroom activities.	3.18	0.87
58.	I prefer to learn mathematics using an interactive multimedia courseware with a teacher acting as a facilitator.	3.73	1.01
59.	Students should learn mathematics with textbooks without an interactive multimedia courseware.	2.33	1.21
60.	I will suggest to my friends to use an interactive multimedia courseware in learning mathematics instead of textbooks.	3.43	0.64

Table 6 shows that the mean ranged from 2.20 to 3.73. Items 4 and 6 possessed the highest mean values while item number 3 possessed the lowest.

DISCUSSION

Creating user-friendly and interactive multimedia (IMM) courseware in the form of stand-alone CD-ROMs is a tedious and complex task. A courseware designer/ developer requires multiple levels of design and development efforts and skills. He/she is usually challenged with the task of selecting content, appropriate screen designs, commonly accepted user-interfaces, clear directions for access and system and application software that are appropriate for courseware development, as well as appropriate digital multimedia elements. Despite the tedious and complex task, will a particular IMM courseware be accepted by its users?

Content in the Multimedia Courseware

Most of the students agreed that the content of this IMM courseware was suitable for the learning of "Goal Programming". Students liked the content of this courseware mainly because the courseware

allowed them to move freely and they were able to repeat the same lesson as many times as they wanted. Mathematics software that allows students to repeat lessons and help them to improve can focus on mastery in a learning environment.

Interactivity in the Multimedia Courseware

Analysis shows that most of the students agreed that this courseware was interactive mainly because the courseware was designed and developed based on an interactive, dynamic and effective concept. Multimedia resources can be used to develop active learning by allowing the user to be an active learner (Baharuddin Aris, 1999). It is also obvious from the study that students liked to use the courseware to discover information and learn actively. The interactive nature of multimedia courseware is considered to be its most important learning feature and enables students to achieve topic goals and to receive meaningful intrinsic feedback (Laurillard, 1993).

Navigation in the Multimedia Courseware

The respondents agreed that the navigational assistance of the multimedia courseware was functional. The amount of navigational assistance needed depends on the size of the knowledge base (Elissavet et al. 2003); the usefulness of the aids that are already part of the authoring softwar, and the types of links the software allows (Locatis et al., 1989).

Students who navigate in hypermedia courseware enjoy convenience and flexibility but different navigation patterns may be attributable to different courseware structures (Sun, et al. 1998). It can be interpreted that this IMM courseware was lacking in terms of glossary, summary and the students' comment key.

Feedback in the Multimedia Courseware

Students agreed that this multimedia courseware provided feedback immediately after a response, enabling the correctness of a response to be verified, thus allowing the students to check their performance. To some extent, however, they were hoping that the courseware could provide them with a more in-depth feedback to answers. It is obvious that students needed more guidance about how to correct their answers or hints on how to try again. This kind of feedback was not provided in the courseware.

Elissavet et al. (2003) stressed that simple answers such as right or wrong cannot provide any information about how learners should correct their performance. A more helpful form of extrinsic feedback would give the learner information about how to adapt and correct their performance; such feedback would include responses accompanied by explanations.

Screen Design in the Multimedia Courseware

From the responses of the students, the presentation of information can captivate the attention of students and stimulate recall. Also, the colour of the text follows the principles of readability. The use of graphics support meaningfully the text provided. It was also obvious that sound was a necessity in presenting information. Students also hoped that the presentation of information could be more captivating with the quality of the text, images, graphics and video being improved.

Moving images can effectively portray procedures in which motion is essential (Ornstein, 1995). The video should stimulate, motivate and inform the learner to act on given information (Beaudin et al. 2002). This is in line with the study of Elissavet et al. (2003) on hypermedia courseware evaluation,

that is, different screen elements should be used to present stimulating information that will motivate and assist the learners in retaining and recalling the information.

Students' Preferences toward the Use of an IMM Courseware Compared to Traditional Methods of Learning "Goal Programming"

From the analysis, it is evident that many students in the Sinaran Institute prefer to learn mathematics with an interactive multimedia courseware that provides challenging quizzes and activities than using textbooks. Many of them also prefer to learn mathematics with an interactive multimedia courseware provided that their teachers still play their role as facilitators. These students are also willing to suggest the use of the interactive multimedia courseware in learning mathematics to friends. Baharuddin Aris (1999) pointed out that teachers should indeed become facilitators to learning by guiding and helping students to access, organise and obtain information to seek solutions to problems. Their support is essential while students are using an IMM courseware.

CONCLUDING REMARKS

From the results and discussion of this research, it can be concluded that this IMM courseware is suitable as a supporting learning aid for students learning "Goal Programming". Students perceive this IMM courseware as user-friendly and capable of enhancing the learning of the subject. However, the teachers must act as facilitators in the classroom.

REFERENCES

Avouris, N.M., Tselios, N. & Tatakis, E.C. (2001). Development and Evaluation of a Computer-Based Laboratory Teaching Tool. *Computer Application in Engineering Education,* 9 (1).

Baharuddin Aris. (1999). The Use of Information Technology in Education: Using an Interactive Multimedia Courseware Package to Upgrade Teachers' Knowledge and Change Their Attitudes. An Interactive Multimedia Doctoral Thesis Produced in the CD-ROM Format.

Barrese, R. M., Calabro, G., Cozza, S., Gallo, T. & Tisato, F. (1992). CAMCE – An Environment to Support Multimedia Courseware Projects. *Educational and Training Technology International,* 29 (1).

Beaudin, B. P., & Quick, D. (2002). Instructional Video Evaluation Instrument. *Extension Journal*, 34 (3).

Bork, A. (1997). The Future of Computers and Learning. *THE Journal,* 24 (11).

Elissavet, G., & Economides, A. A. (2003). An Evaluation Instrument For Hypermedia Courseware. *Educational Technology & Society*, 6 (2).

Knox, A. B. (1977). *Adult Development and Learning*. San Francisco : Jossey-Bass Inc. Publishers.

Locatis, C., Letourneau, G., & Banvard, R. (1989). Hypermedia and Instruction,

Educational Technology Research and Development, 37 (4).
Molenda, M., Pershing, J. A. & Reigeluth, C. M. (1996). Designing Instructional Systems. In : Craig, S. L. (Ed.), *The ASTD Training and Development Handbook - A Guide to Human Resource Development*. London : McGraw-Hill.

Ornstein, A.C. (1995). *Strategies for Effective Teaching*. 2nd, London: Brown & Benchmark Publisher.

Sander, U., Kerlen, G., Steinke, M., & Huk, T. (2003). Evaluation of Two CD-ROMs from a Series on Cell Biology. *Cell Biology Education,* 2.

Sun, C.T., Chou, C., & Lin, B.K. (1998). Structural and Navigational Analysis of Hypermedia Courseware. *Institute of Electrical & Electronic Engineers,* 11(7).

Zemke, R. & Zemke, S. (1995). Adult Leaning – What Do We Know for Sure? *Training*, June 1995.