

The Design and Evaluation of Multimedia Learning System

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ABSTRACT

The design and implementation of multimedia as an educational tool has received a considerable amount of attention in the recent years. Many theories and guidelines have been developed in order to assist teaching and learning of various subjects.

In this study, an interactive multimedia learning system in the field of Biology has been developed to teach the structure and the function of three different cells; animal cell, plant cell and bacterial cell. The system also explains the stages of the animal cell mitosis. This system has been constructed by using a combination of graphics, text, animation and voice-over to deliver the information.

This paper will demonstrate how such a system is designed on the basis of the current field of, the instructional design, the cognitive perspective, the attentional design and the design guidelines.

Furthermore, the proposed multimedia system was evaluated by using formative and summative means. The results of the study indicate some positive outcomes reported as a result of using the multimedia to deliver certain topic in comparison to the traditional mean. These results are significant and emphasize the importance of using multimedia to enrich the learning environment, and to improve the quality of understanding complex topics.

Keywords: Multimedia, Instructional Design, Cognitive, Guidelines

1. INTRODUCTION

Learning some topics specially the complex ones from textbooks has certain difficulties for users to learn and understand them, so here the use of multimedia came to make these topics easy to learn and understand. Multimedia can be defined as the “integration of media such as text, sound, graphics, animation, video, and images in a computer system” (Jonassen & Reeves, 1996) [1]. “Multimedia learning is learning from words and pictures, and multimedia instruction is presenting words and pictures that are intended to foster learning” (Richard E. Mayer, 2003) [2].

Numerous studies over the years have shown that interactive multimedia learning takes less time, is enjoyed more and increases learning. In a review of numerous meta-analysis studies Najjar (1996:30) found that "learning was higher when information was presented via computer-based multimedia systems than traditional classroom lectures"[3]. Similarity other studies have found that interactivity has a strong positive effect on learning (Bosco, 1986, Fletcher, 1989, 1990, Stanford, 1990). For example, Bosco (1986) reviewed 75 learning studies and found that learners learn faster, and have better attitudes toward learning when using interactive multimedia.

The aim of this paper is to illustrate how important is the using of the instructional design in designing and developing a learning system to teach the different types of cells and the animal cell mitoses, and the key aim is to conducted if the design strategy and the use of multimedia have helped to improve the learning of the topic and make it much easier.

The first part of the paper is a description of the design strategy, and this will demonstrate how the system have been designed to promote learning; starting from selecting the topic, developing storyboards, constructing the instructional design which was based on a cognitive theories and a design

guidelines, construct the prototype and finally build the complete test system. The second part of the paper is an evaluation study that was conducted to evaluate if the learning outcomes of the topic have been achieved through this multimedia learning system.

2. DESIGN STRATEGY

Selecting the topic (cells and mitosis) and the target users were the first step in designing the system, this topic was chosen because it was felt that approaching this topic through traditional means e.g. textbook present certain difficulties. This system is designed for learners of 16 years old and above who want to learn about the different cells and the cell mitosis process in easy and interactive way, also another source for students in high school who are studying Biology. After selecting the content, learning outcomes were defined include the following:

Knowledge:

- 1) Describe the cells structures and their functions.
- 2) Describe animal cell mitosis.

Abilities:

- 1) Distinguish between cells on their different structures and functions.
- 2) Demonstrate knowledge of animal cell mitosis.
- 3) Distinguish among the stages of mitosis on stage images and descriptive information on cell division.

Developing storyboards, incorporating information design, navigation design and presentation design was done, to build the first prototype for the instructional design.

2.1 Instructional Design

In order build any multimedia system to aid learning, an instructional design should be constructed. Instructional design is a “systematic process of translating general principles of learning and instruction into plans for instructional materials and learning” (Sara McNeil, 2004) [4] this requires using learning and instructional theories to ensure both the quality of instruction as well as achieving the described learning outcomes. These learning and instructional theories are:

2.1.1 Cognitive Perspective and Attentional Design

According to this multimedia learning system, the cognitive perspectives of multimedia learning have been taken into consideration. For example memory “Memory is the mental storing of information and the ability to recall that information for a later time” (Wiki S, 2005) [5], cognitive psychology and cognition theory. Based on research in the cognitive science, three assumptions about how the human mind works and learn from words and pictures was made, (Mayer, 2002) [6] these are:

- Dual Channel Assumption: This states that working memory can process visual and auditory information simultaneously.
- Limited Capacity Assumption: This states that human cognitive system has a capacity for holding and manipulating knowledge.
- Active Process Assumption: This stats that meaningful learning happens when the learners engage in process within the channels, including words and pictures, organize and integrate with each other and appropriate prior knowledge.

The research defined that multimedia learning faced potential problem in which learner's capacity for cognitive processing is limited to the cognitive processing demands during learning. This called cognitive overload, which is a challenge for the Instructional designers. There are three kinds of cognitive processing demands in multimedia learning, essential processing, incidental processing, and representational holding. Cognitive overload occurs when the total intended processing exceeds the learner's cognitive capacity. Based on the cognitive theory, eight principles that aid multimedia learning which was introduced by Richard E. Mayer, to reduce cognitive overload and they are explained below (Mayer, 2002) [7]:

1. Multiple Representation Principle: more effective learning from words and pictures than from words alone.
2. Contiguity Principle: it is better to present words and pictures simultaneously rather than separately.
3. Coherence Principle: Deeper learning when extraneous words, sounds, or pictures are excluded rather than included.

4. Modality Principle: more effective learning from animation and narration than from animation and text.
5. Redundancy Principle: more effective learning from animation and narration than from animation, narration and on-screen text.

“Animation has great potential to improve human-learning, especially when the goal is to promote deep understanding” (Mayer 2002) [7].

6. Personalization Principle: more effective learning when words are presented in conversational style rather than formal style.
7. Signalling principle: more effective learning when key steps in the narration are signalled rather than non-signalled.
8. Interactivity principle: more effective learning when learners are allowed to control the presentation rate than when they are not.

2.1.2 Design Guidelines

The guidelines aimed to predict what would be attended to in the system and to reduce any design problems. A subset of the applied guidelines is given below.

Still Images

- Use highlighted technique. Change the colour of the buttons and when the mouse is over the image, it is highlighted to draw attention to it.

Moving Images (Animations)

- In the animation screen, learners will read the definition of the mitosis then explore the screen and the buttons, and when they are ready, they can play the animation, so there is no text that the learners will read while the animation is playing. Only captions of the names of the stages will appear when it is mentioned in the narration.
- The animation has been made to be the only important thing in the screen, so there is no static object that needs to be focused on.

Text

- The text selected is clear and readable, and special attention was paid for the choice of the colours and font. Attempts have been made not to include a lot of text in the application.

Sound (voice-over)

- Only one standard of sound has been presented, because if there are multiple standards of sound, it will interfere with each other and distract focus.
- No background music is used; because the narration will not be clear and the learner might get confused.

Usability

- “Usability is the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or components” (IEEE 90) [8]. This system was made to be usable by the learners.

Accessibility

- Accessibility is defined as “The degree to which a software system or component facilitates the selective use of its components” (Boehm 78) [9]. Content is accessible when it may be used by someone with a disability. This system is accessible by offering two ways of learning which are:
 - Animation with narration.
 - Text and Pictures.

2.1.3 Elaboration theory

Wilson defined the elaboration theory as “a model for sequencing and organizing courses of instruction. It applies to the design of instruction for the cognitive domain” (Wilson, B., & Cole, P. 1992) [10]. According to elaboration theory, instruction should be organized in increasing order of complexity for optimal learning. For example, the animal cell structure and functions are explained in

the first section of the system, and then the learners can start learning the second section which is about the mitosis of the animal.

3. EVALUATION STUDY

Previous studies in evaluation gave a useful indication to its definitions. Probably the most frequently given definition for evaluation “is the systematic assessment of the worth or merit of some object” [11]. But this definition is hardly perfect. There are many types of evaluations that do not necessarily result in an assessment of worth or merit of descriptive studies. Another definition which might be more suitable to this study is “Evaluation is the systematic acquisition and assessment of information to provide useful feedback about some object” [12]. Recent study considers of evaluation, defined it as “is to determine the effectiveness of a program in light of the attainment of pre-set priorities and goals. Evaluation helps documenting whether a program is accomplishing its goals or not. It identifies program weaknesses and strengths and the areas of the program that need revision” [13].

And here is the another definition of the evaluation form usability perspective “Evaluation is concerned with gathering information about usability or potential usability of a system in order to either improve features within an interface and its supporting materials or to assess a completed interface.” [14] (Alan Dix 1993). With respect to the mentioned definitions, the last two definitions would best suit the present study because the usability and the goals of the system are evaluated, and the areas of the program that need revision needs to be identified.

Evaluation goals have been defined, and two types of evaluation have been used which are:

- Formative evaluation

Formative evaluation is designed to collect data while the system is being developed with the intention to improve it. Formative evaluation provides ongoing feedback on how the different components of the system are working and leads to decisions regarding what needs to be enhanced, what needs to be deleted and what needs to be added.

- Pilot study

The evaluation methods was constructed and tested by one user to clarify the suitability of this method.

- Summative evaluation

Summative evaluation is designed to gather conclusive data that indicates how effective the overall system is. Summative evaluation results in decisions whether or not to continue a system.

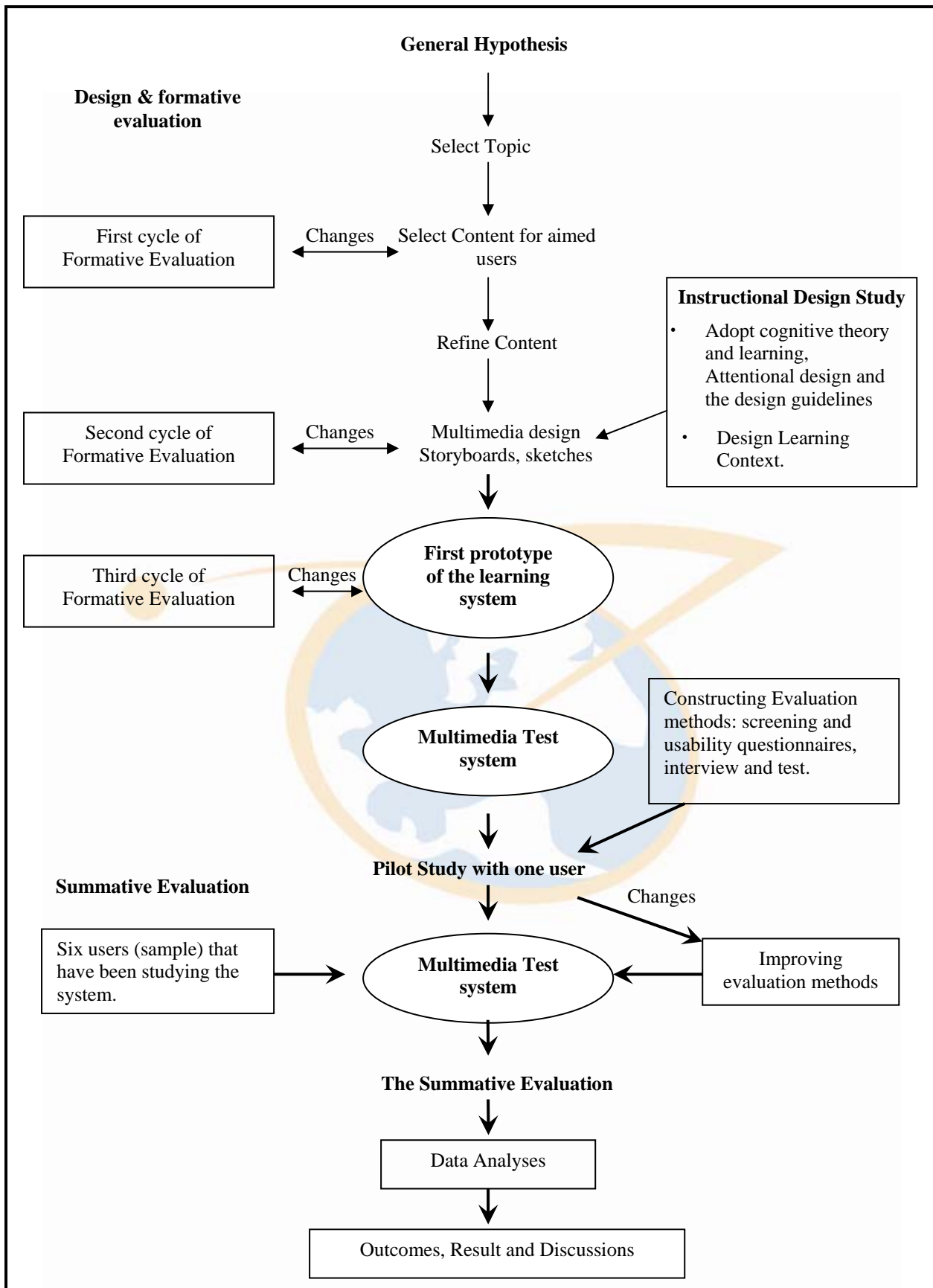


Figure 1: The Model for the Design and the Evaluation Strategy

3.1 Formative evaluation and pilot

In order to evaluate any system, there should be a list of evaluation goals that are aimed to achieve from the evaluation study and its methods. The evaluation strategy was adapted from a study about design and evaluation multimedia of VSM made by Dr Susan Jones [15].

Here are Formative and Summative Evaluation Goals of the learning cells and mitosis multimedia system:

1. Accurate content of the topic.
2. Appropriate presentation and delivery of the multimedia system.
3. Checking the usability of the system and its quality in use, such as screen design and layout, user control and freedom learnability, flexibility, navigation, efficiency and memorability.
4. To check whether the learning outcomes have been achieved through the system.

First cycle of formative evaluation with two students

The formative evaluation was conducted with two students at the early stage of designing the instructional multimedia (context and sketches) to assess the content and the presentation of the system. The feedback from both students were almost the same, that the topic was explained clearly with text, diagram drawings and screen layouts but the text was dense. The animation presented in rough sketch looks like it could teach a novice a complicated issue, but it does look a little complex. The feedback resulted in, a slight adjustment in reducing the text and simplification the animation.

Second cycle of formative evaluation with Pharmacy student

To establish accurate content of the topic (is it suitable for the aimed target users, is it simple or complicated) a second formative evaluation was conducted with pharmacy student who have knowledge in cell biology, the feedback was that the text and narration were extensive, a bit complicated and needs to be simplified to become appropriate for the target users, and the drawings of the cells and mitosis were also seen a little complicated. Extensive modifications were required to improve the content of the topic. First the narration, the text and the graphics were completely changed to simple easy and more effective and this was done through the help of the pharmacy student by providing useful resources about the topic. After continuous modifications, she finally accepted the content of the multimedia system. This student suggested having labels on each part of the animal cell in the mitosis process animation screen, but this suggestion was not taken into consideration as the users of the system will first study the animal cell's structures and functions and learns about each part of the cell before they move to the mitosis. Moreover the voice over with the animation will help to learn about the names of the parts.

Third cycle of formative evaluation with Physician

The third formative evaluation was conducted with a doctor to evaluate the prototype of the animation for animal cell mitosis. The aim was to further check goals 1 and 2 as well goal 3. The feedback showed that there is a small mistake in the mitosis animation in the third stage (Metaphase) of the mitosis and she rectified this correction by drawing the metaphase. It was helpful and lead to a complete design of the test system then to start the pilot study.

Pilot study with one target user

The pilot study was conducted through four stages, and these were sampling strategy, drafting a pilot protocol, testing them in one user and finally redrafting them.

- Sampling strategy:

Before designing any questionnaires or interviews, it is usually advised that the sampling method has to be then decided. Research defined different types of sampling methods including probability and non-probability sampling. Probability sampling is used when the sample is chosen at random, a method which was considered unsuitable to the current study. So different techniques of non-probability sampling were reviewed including Quota, Purposive, and snowball sampling techniques (Saunders, Lewis et al. 2003). Purposive sampling was selected because only the specified aimed target users are going to use this system. Neuman (2000) argues that this type of sampling "is often used when having a small sample and when attempting to select cases that are particularly informative". [16]

- Drafting the pilot protocol

The protocol for the pilot was as follow:

1. Screening Questionnaire to find out relevant information about the users in terms whether or not they benefited from the multimedia system.

2. Usability Questionnaire to assess the usability of the system.
3. A Test to assess the knowledge of the target users after they used the system.
4. An interview to test the target users to find out what they had learned about the topic, and get some general feedback about the topic itself and multimedia delivery in general. The two questionnaires and the interview were designed such that they would engage the respondent's interest, encourage co-operation and generate reliable and accurate data. A questionnaire "is a set of questions designed to generate the data necessary for accomplishing research objectives. It is a channel for collecting data from the research sample. Therefore, it should be coherent, carefully designed, using clear wordings" (Oppenheim 2001) [17]. On the other hand Kahn and Cannel (1957) describe interviewing as "a conversation with a purpose between two or more people and they claim that interviewing is widely used by qualitative authors". [18]

- Testing the pilot protocol

The two questionnaires, the test and the interview were finally piloted with one target user. This improved the questionnaire further by facilitating the removal of some ambiguities in some questions.

- Redrafting the pilot protocol

Modifications were made to the test as well as to the interview but not to the screening and usability questionnaires, for example the test was founded very difficult and didn't cover the entire content area, and the interview included many of questions that could be asked by a single question. Overall the pilot study was a useful tool to come up with a suitable protocol that will be used in the summative evaluation. After completing the polite study the complete learning system was ready for the summative evaluation.

3.2 Summative evaluation

In order to find out if the evaluation goals have been achieved, a summative evaluation was required with a number of target users. The same protocol was used similar to the pilot study and all the documentations had been refined and are ready for this investigation. In total 10 target users went through this study from the start but the evaluation was conducted with only six users because the other users did not show any commitment in learning through this system. The data collected provided a very rich set of data, including screening data, quantitative data from usability questionnaire, and also a qualitative data from the test and the interview.

3.3 Data Analyses and results

3.3.1 Quantitative:

Six users completed the usability questionnaire. The aim of the quantitative analysis is to assess the effectiveness of the usability of the multimedia learning system which is a very important aspect in any system and without good usability of a system; the system will not meet its design goals. The usability questionnaire was managed through collecting and analyzing each question.

Question 1 (from 1 to 3 is bad and from 4 to 6 is good)

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------------------|---|---|---|---|---|---|
| User control and freedom | 5 | 5 | 5 | 3 | 5 | 4 |

1 user (17%) found that user control and the freedom of the system is bad and the other 5 users which represent 83% were satisfied with this usability criterion.

Question 2

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------------------|---|---|---|---|---|---|
| Screen design and layout | 5 | 5 | 5 | 3 | 5 | 6 |

1 user (17%) found that the system offers bad screen design and layout and the other 5 users (83%) were satisfied with this usability criterion.

Question 3

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------|---|---|---|---|---|---|
| Consistency | 6 | 5 | 4 | 4 | 4 | 5 |

100% agreed that the system offers a good consistency and they were satisfied with this usability criterion.

Question 4

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------|---|---|---|---|---|---|
| Navigation | 4 | 4 | 6 | 5 | 5 | 5 |

100% agreed that the system offers a good navigation and they were satisfied with this usability criterion.

Question 5

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------|---|---|---|---|---|---|
| Learnability | 5 | 3 | 5 | 3 | 6 | 6 |

2 users (34%) found that the system offers bad learnability and the other 4 users (66%) agreed that the system was easy to learn.

Question 6

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|----------------------------|---|---|---|---|---|---|
| Flexibility and efficiency | 5 | 2 | 5 | 3 | 5 | 5 |

2 users (34%) found that the system inefficient and less flexible and the other 4 users (66%) agreed that the system was flexible and efficient.

Question 7

| Users Number | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------|---|---|---|---|---|---|
| Memoability | 5 | 5 | 5 | 4 | 4 | 4 |

100% agreed that the system easy to remember

All of the 6 users agreed and responded that the system provides a good navigation and memoability. Also most of the users agreed that the system provides a good user control and freedom, screen design and layout, consistency, navigation, learnability, the Flexibility and efficiency. Overall the usability of the system was good, but it is worth mentioned that the other small percentage of users found that some of the usability criteria didn't support the system, which is a factor that should be taken into consideration in future study.

3.3.2 Qualitative:

Six users were interviewed. The aim of this interview was to show how suitable is the system for the users, how they benefited from it, their opinion of the system and their recommendations to improve it. There are many qualitative analysis strategies (Saunders, Lewis et al. 2003). A particular approach that is common to all of these strategies (Saunders, Lewis et al. 2003) is disaggregating the data collected into meaningful and related categories, and this was done by:

1. Understanding and managing data.

The interview has been divided into 9 categories based on the questions of the interview and the test, which are:

- The way they went about using the system and the time they took to learn it.
- How enjoyable was the system.
- The results of the test.
- How easy was the topic to learn and was the system to use.
- What do they prefer the traditional way of learning or multimedia learning?
- The aspects that they like most about the system.
- The aspects that they didn't like about the system.
- Their recommendations to improve the system
- And if they would recommend it to anyone within the target user who want to learn about cells and mitosis.

2. Identify key themes

- All of users were able to learn it by starting with the different types of cells and then cell mitosis, all of them liked how it was structured, most of them spent between 2 weeks to learn it but they didn't spent the entire time studying.

- Most learners enjoyed it except user 4.
- All of the users passed the exam.
- All of the users found the system easy to learn and use in general, but users 1, 3, 5, and 6 found it very straightforward and user 2 found it not too difficult.
- five users 1,2,3,5 and 6 strongly preferred multimedia learning than using the traditional way like books, because as they mentioned books is a resource that only provides passive learning without interaction, no animation that can attract the user. Furthermore they considered books as static as they do not move or give any expressions, while multimedia learning system is more interactive with colored graphics, text, animation and voice over. Also it is much more interesting and entertaining than textbook, but one user who is user 4 preferred the testbook and explained that books can have all this information in three or four pages, but in this system you have many screens which might confuse the user.
- All users like different aspects in the system except user 4, such as how the components of the cell were structured, how the voice over is fitted with the animal cell mitosis animation, and the method of explaining the information in the learning system and changing the colors of the cells parts when the mouse is over them.
- All users will recommend it to those who want to study this topic within the target users, even user 4 but not as a single source rather than a supplementary source with book.

3. Identify individual key theme

Some users didn't like some aspects of the system and made some recommendations to improve them. For example, user 1 didn't like the quiz and felt it was not challenging, because after finishing the quiz, if the users wanted to try it again they got the similar questions. So user 1 recommended changing the quiz and making the screen less crowded. User 2 didn't find anything that was unsatisfactory but he mentioned that the system can be improved by having a real video of the animal cell mitosis. User 3 recommended adding a button to change the color of the background so that the user can have the control over changing the color of the background. User 4 however, didn't like this recommendation and felt there were many screens and little information, so he recommended reducing the screen and including more information. Users 5 and 6 has similar opinion and they didn't like that when they click in any part of any cell to hear the narration, and in the same if they clicked in another part before the first description finished and without using stop sounds button, the two narrations will be play together, so they recommended when they played another part the previous narration should stop.

4. DISCUSSION

Generally the evaluation goals have been successfully achieved through this study, as the results indicate that the majority of the users really liked the system and its content and found it easy to use and to learn as well. All of the 6 users achieved the learning outcomes specified for the system by doing the test, and enjoyed studying this topic through multimedia system, despite the fact that they had never used multimedia system to study that topic. Only one user didn't like the approach and didn't enjoy the experience at all. Each user held different opinion concerning which aspects of the system they liked the most and which aspect they didn't like, and a provided some recommendations on how to improve the system.

Individual differences of the users

It is not generally inaccurate to claim that the animation and narration result in deeper learning than still images and text, because of individual differences among learners, some of the learners may prefer and learn better from pictures and text rather than animation and narration. Furthermore the learners with disabilities or who has difficulties with the narration and animation might benefit more from using text and pictures. All the 6 users have used multimedia learning materials before, but they were divided into two groups:

1. Users that did not have pervious knowledge about the topic before, but have used multimedia learning materials before, there were users 3 and 5. The results indicated that they liked it and benefited from it a lot and expressed that they preferred learning through multimedia system rather than traditional format.
2. Users with pervious knowledge about the topic, users 1,2,4,6. These four users had used multimedia leaning materials before. They pointed out that they liked the system and

increased their knowledge of this topic and preferred using this way of learning, except one user which is user 4 who preferred learning from textbook.

Validity and reliability of the data

Attempting to address issue of validity and reliability of any research data is an important stage in any study to ensure reliable and valid results and conclusions.

In order to insure the suitability of the results, the following measures were taken:

- Informing the users of the interview and questionnaires
- Digital recording for the interviews was done.
- In addition to that the interviewees were sent a summary of the interview after conducting the interviews as a member check technique to enhance validity.

Limitations of the Study

The multimedia learning system was offered to 10 users and only 6 users actually completed the study. The selection of a small sample was due to the time constraint. Therefore to enhance the study in future a larger sample will be evaluated.

When designing the screening questionnaire, research about different scales that are available was done, and it found out that the questionnaire should have one suitable scale for example likert scale “A type of composite measure using standardized response categories in survey questionnaires. Typically a range of questions using response categories such as strongly agree, agree, disagree, and strongly disagree are utilized to construct a composite measure” [19], but it was felt that using different scaling methods in the screening questionnaire would be more suitable to this study and analysis for better engaging with the users.

With respect to issues of validity and reliability of the data, it is realized that some data could be subjective depending on truthful and honest answers, which is considered as a limitation of this study. In order to assess the reliability of the qualitative data the concept of test / retest reliability should be used. The test / retest reliability refers to consistency of data over time, which means that the data obtained from the same interviewee should be consistent on different occasions. Kline (1993) suggests that time gap between two interviews should not be less than 3 months [20]. But the period of time that allowed starting the first interview and finishing the study was less than two months so the retest reliability for qualitative data couldn't be done may be for larger studies. The last limitation is that interviews were analysed by looking for common theme, so if the study had a larger sample and time allowed another more professional way could be use which is coding interviews or even grounded theory.

Improvements of the system

Interview results make a number of different recommendations some which have been considered and some haven't. The changes that will be made to the system is improving the quiz by changing the questions after each attempt of answering, because this change will make the quiz more challenging and will test the users knowledge in different aspects. Another change is adding real video of the animal cell mitosis to be with the animation, and this is a really good idea which will lead to better understanding of the mitosis. In the text and pictures screens, two users had recommended making the screen less crowded by putting the information in two screens instead of one, and this change will be taken into consideration because there were obviously crowded screens comparing with the other screens. Furthermore, two users recommended having this option, when you click and listen to the narration of one part of any cell and if you would like to click and hear another part before the narration of the first part finished, the first sound should stop and play the second sound only, although there is a button for stopping the sound but this way is easier and will be implemented.

However there were two recommendations that were not taken into consideration. The first one was from user 3 which suggested adding a button to change the background color for the screen. This hasn't been considered, because it won't add any value or improve any thing within the system. And the second recommendation was from user 4 which suggested reducing the number of screens and adding more information. What this user suggested wasn't acceptable because the content was chosen and evaluated with expert in this topic who provided a suitable content and information that suited the specific target users.

5. GUIDELINES

The aim of this section is to provide any system developers (like teacher who setting out to provide multimedia for learning) with some guidelines that could assist them in developing such system. It should be noted that these points provide guidelines only and shouldn't be considered as a full plan in developing system, because the references that are mentioned in this study or any other new referenced should be used as well. Here are the guidelines:

- First, after selecting the topic and the content of the topic, an instructional design should be constructed in the initial stages based on a theoretical framework of cognitive theory of multimedia learning, principles that aid multimedia learning, learning theory attentional design and the design guidelines to ensure the quality of instruction and to ensure as well that the system meets its aims and leaning outcomes.
- Second, conducting formative evaluation at early stage in the design process and on a continuous basis in order come up with a good prototype that is evaluated to finally construct the complete test system.
- Finally, the summative evaluation is an important stage in system evaluation. Before conducting the summative evaluation, a pilot study should be carried out first, by construct a pilot protocol then implement it with a small number of users to check the suitability of the this protocol before using the same protocol for the summative evaluation. The more methods and users used for the evaluation the clearer and the better results will get.

To improve the quality of the present study a number of measures will be taken to improve the system, and by learning from some of the limitations, the proposed system will helpfully be enhanced.

6. CONCLUSION

By taking into consideration the cognitive theory of multimedia learning, the principles that aid multimedia learning, the attentional design, the learning theories and the design guidelines, the design of multimedia system for learning will improved. The paper has shown how these theories, guidelines and principles have been used to come up with multimedia instructional design that promotes learning.

The participants showed different opinions, but the mostly liked the system except for one user, however there was some users that didn't learn about this topic before and some did and both benefit from the system.

This study start with formative evaluation, pilot study, then summative evaluations, to get the results which shows that the system met its goals and in the same time give some ideas to improve the system more to server the target users. This study shows that the users enjoyed learning the topic through the appropriation design and delivery of this multimedia system. This approach of delivering such a topic enabled the user to learn and engage with the topic more that they would do with the traditional way of learning. Many other simple or complex subjects would be better to delivered and learned through multimedia system, as many subjects are now delivered in this way and the results are significant.

ACKNOWLEDGEMENTS

I would like to thank Dr Susan Jones from University of Sunderland and Dr Meenas Hassan form Ministry of Education for helping me in this paper. Many Thanks for all the participants in this study. Lastly I would also like to acknowledge the help for all the researches in my references.

REFERENCES

- [1] Jonassen, D. H., & Reeves T. C. (1996). Learning with technology: Using computers as cognitive tools. *Handbook of research for educational communications and technology* (pp. 693-719).
- [2] Mayer, Richard E. Moreno, Roxana. (2003). Nine Ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist*, Vol. 38, no 1, pp. 43-52.
- [3] Hick, S. (2001). Benefits of Interactive Multimedia courseware. [Online]. Available from: <http://http-server.carleton.ca/~shick/mypage/benefit.html>.
- [4] McNeil, S. (2004). Instructional Design. [Online]. Available from: <http://www.coe.uh.edu/courses/cuin6373/whatisid.html>.
- [5] Wiki, S. (2005). Memory. [Online]. Available from: <http://sharma-home.net/wiki/Memory>.
- [6] Mayer, Richard E. (2003). Cognitive Theory and the Design of Multimedia Instruction: An Example of the Two-Way Street Between Cognition and Instruction. [Online]. Available from: http://www.fp.ucalgary.ca/maclachlan/cognitive_theory_mm_design.pdf.
- [7] Mayer, Richard E. Moreno, R. (2003). Animation as an aid to multimedia learning. *Educational Psychology Review*, Vol. 14, No. 1, pp. 87-99.
- [8] [IEEE 90] Institute of Electrical and Electronics Engineers. *IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries*. New York, NY: 1990.
- [9] Boehm, Barry W.; Brown, John R.; Kaspar, Hans; Lipow, Myron; MacLeod, Gordon J. & Merritt, Michael J. *Characteristics of Software Quality*. New York, NY: North-Holland Publishing Company, 1978.
- [10] Wilson, B., & Cole, P. (1992). A critical review of elaboration theory. *Educational Technology Research and Development*, 40 (3), pp 63-79
- [11] William, K. (2002). Introduction to Evaluation?. [Online]. Available from: <http://www.socialresearchmethods.net/kb/intreval.htm>.
- [12] William, K. (2002). Introduction to Evaluation?. [Online]. Available from: <http://www.socialresearchmethods.net/kb/intreval.htm>.
- [13] maricopa center for learning & instruction maricopa community colleges. (2000). What is Evaluation?. [Online]. Available from: http://www.mccli.dist.maricopa.edu/ae0/e_what.html.
- [14] Dix, A. (1993). Evaluation Techniques. *Human-Computer Interaction*. Prentice Hall. Page No, 363-374.
- [15] Jones, Susan, Cockton, G. (2001). The design and evaluation of multimedia on the viable system model for senior manager. University of Sunderland.
- [16] Saunders, M., P. Lewis, et al. (2003). *Research methods for business students*. London, Prentice Hall.
- [17] Oppenheim, A. (2001). *Questionnaire design, interviewing and attitude measurement*. London, Continuum.
- [18] Kahn, R. and C. Cannel (1957). The dynamic of interviewing. New York, John Wiley.
- [19] Centre for program evaluation. (2002). likert scale. [Online]. Available from: http://www.ojp.usdoj.gov/BJA/evaluation/glossary/glossary_1.htm.
- [20] Kline, P. (1993). *The Handbook of Psychological Testing*. Lo