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Developing Learning Environment Using Interactive Multimedia

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Abstract

The study was conducted in three phases that is testing, using multimedia and observation of the controlled group. Major objective of the research were to assess the implications of software development design on learners and to identify effects of interactive multimedia environment on learning patterns of learners' at graduate level. The researchers followed experimental design of research and selected a group of six learners from social science departments through purposive sampling technique. Researchers observed and interviewed the sampled learners who used LMS software. The analysis was made to find out results of patterns of multimedia interactions. It was found that in controlled environmental situations, the learners effectively learned by using interactive multimedia. Learners' capacity of learning was developed when they were given freedom to use variety of learning strategies. These learning strategies were based on the ability and cognition of individual learner. It was also found that the interface design also facilitated exploration as well as, provided guidance to make choices. Learners used concept maps as an important tool which helped them in their structured learning. The research concluded that capabilities of the learners may be evoked through nodes, internal motivation and use of innovative learning techniques.

Keywords: multimedia; learning environment; interactive multimedia environment

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Introduction

Computers have been used for educational purposes more than two decades ago. Recently computer technology has been enhanced with deep advances in the field of multimedia which is commonly referred to as information delivery in the form of text, graphics, animation, audio and video via computer (Hood, 2007, pp., 2007). In the advanced countries, where multimedia has been widely used to convey information education is imparted in various forms. Efforts to use information and multimedia technology in education in Pakistan has become increasingly active during the last decade (Amble, 2012, pp. pp.339-353). The present research intends to report the interaction patterns of the use of multimedia software in their learning. Following are the patterns of interaction that are used to develop learning environment.

Interaction patterns

Major advantage of using interactive multimedia is the ability to allow learners to explore learning material by variety of ways. Majority of the researchers believed that the learners may develop better understanding of the concepts if they are given opportunities to learn by multi-perspectives. This understanding of the learning content may be enhanced by developing connections in knowledge and the learning content. However, (Duit & Treagust, 2012), and (Bozer, Levin, & Santora, 2017) identified that learner's interaction in the learning environment is a complex concept and it varies form one individual to another.

The cause of these variances was stated by researchers such as (Czaja, Boot, Charness, & Rogers, 2019), (Johnson, 2013) and (Lidwell, Holden, & Butler, 2010) who found out that these differences occur due to learning individual differences. These individual differences were rooted in the variance of ability to process information which is found among individuals, cognitive style, levels of existing knowledge and intrinsic motivation.

According to majority of the researchers such as Hammond, Neff, Farr, Schwall, & Zhao (2011) and Masood & Afsar (2017), this phenomenon of pattern of information was due to the factors under influences such design of the software (user friendly), interface design (User controlled) and the type of tasks given to the learners (easy, medium, High).

This discussion brings out the conclusion that the pattern of learner's interaction in multimedia environment depends upon; individual differences of learning styles and cognitive ability, some aspects of

design software development as well as the mechanism of interaction between students and computers (Naz, 2015).

Review of Literature

It is quite evident that the most popular methods for analyzing interaction patterns is by using a log file (Cerezo, Sánchez-Santillán, Paule-Ruiz, & Núñez, 2016). The log file records learner's activities while interacting with software. An analysis of the log files seemed to provide information on the sequence of events performed by a learner (Van Laer & Elen, 2018). These performed acts give out impact of individual difference on their learning styles. The traces of these learning styles were explored and determined in this research.

The composite literature quoted on these traces acknowledged that log files had some drawbacks. These drawbacks were reckoned by (Markham, 2012) who calculated that some selected activities performed on log files were selective in its approach and they did not seem to serve the purpose. Major drawback discussed in this regard was the leaner's background and his or her approach towards basic knowledge (Yasmin, Naseem, & Masso, 2019). So, the literature review of the researchers in this field seemed dissatisfied with the observation techniques only (Khalid & Azeem, 2012). No doubt direct observation methods in such cases are quite effective as they provide accurate picture of the learner's interaction patterns (Aslam, Soban, Akhtar, & Zaffar, 2015). Occurrence of these events may be recorded by using camera records. Based on these records interactive analysis is possible. Keeping in mind these annotations of the previous researchers the present research conducted interview with the learners so that complete information about their basic knowledge may be undertaken.

Incorporation of interaction pattern analysis is not new in the field of educational research as majority of the researchers such as (Handelsman, Briggs, Sullivan, & Towler, 2005) identified effectiveness of use of interaction pattern analysis. The above-mentioned researchers studied the effectiveness of exploration based on concept maps. (Chen, Chou, & Huang, 2016) used the same techniques and studied various patterns of information retrieval and reviewed that learner's motivation, existing knowledge of the learner and individual style of processing the information seemed to affect the memory retention of the learner. Findings of the research studies of (Malta et al., 2018) also seemed to imply similar approach to study the use of media in an educational software.

Literature review of most of the studies (Taylor et al., 2018) in this filed seemed to classify that in an active learning situation a learner developed knowledge through directly constructed patterns, manipulated it, tested and explored it. Learner used all these prototypes to achieve the goal of developing concepts and mind maps (Liu, Chen, & Chang, 2010). It required the effectiveness of interaction between users with a computer. Hail observed that individual differences in learning act as a factor of the effectiveness to interact between learner and the computers (Richardson, Maeda, Lv, & Caskurlu, 2017).

It is evident with the previous research studies that the studies based on learner's interaction patterns is one of the important methods of improving the quality of an educational software (Wong et al., 2015). Efforts were made during the COVID days by most of the software development companies to develop locally made as well as globally developed multimedia software's for these interactive learning operations. Learning Management System (LMS) was first time introduced in Pakistan (Reimers, Schleicher, Saavedra, & Tuominen, 2020). Basic purpose of this software was to fulfill educational needs of the learners during COVID days.

Present pandemic situations demanded an interface of online learning. This paradigm shift seemed to be new for the learners who are habitual to face to face learning. They faced difficulties in using the software and they were in trouble to observe their learning's through this system of education. Even the teachers at university level faced problems in using different type of Medias such as Skype, Zoom and Google classroom. In order to resolve this issue local made learning management systems were introduced in the universities. Same pattern was adopted in the universities of southern Punjab (Pakistan). This seemed to provide relief for the learners and present research identifies the use of those multimedia produced learning environments.

About Software

Learning Management System (LMS) software is a prototype of interactive multimedia physics software developed using Author ware version 3.5 compilation package, based on a combination of methods hypertext, hypermedia and simulation. LMS software contains topic teaching electrostatic physics subjects at Form Five level and there are several subtopics such as electric charge, electric field and potential difference (Keenaghan, 2018).

Objectives of the Research

Objectives of the research were to:

i) Assess the implications of software development design on learners
ii) Evaluate the interface design learning patterns through use of LMS on learner's interaction online patterns
iii) Identify effects of interactive multimedia environment on individual's learning capabilities.

Methodology

The experimental research was conducted in the departments of social sciences in Islamia University of Bahawalpur (Punjab). The research was divided into three phases that were phase one regarding pre-test and posttest, where learners were tested before the application of LMS software and then post-tested after the controlled event in which they were given treatment. In the second phase, the students were showed videos on multimedia and in third and last phase the controlled group was observed keenly by the researchers to assess the changes that were found among the learners after using multimedia and software. In this research, purposively selected learners from the social sciences faculty were taken as a sample. These departments were Department of Education, Educational Training, Social Work Department, Media Studies Department, Health and Physical department, History Department, political Science and Geography departments were taken as a population of the study. Six out of four learners with excellent results in B.S 7th semester and M.A 4th semester, 2020 were selected through purposive sampling technique. So, six students from each department were taken as a sample of the research. Overall 48 learners were taken as a sample of the research. It was assumed that the selected learners will be able to use software effectively in their learning.

Hypertext approach and hypermedia are used to enable exploration between nodes which contains a variety of information in the form of text, graphics, animations and video clips. The simulation approach is to represent an abstract or dangerous process and experimental activities. Exploration and exploration activities are focused on this software to give students the opportunity to build knowledge based on their cognitive strategies and styles.

During the interaction session with the computer, a video camera is installed to observe and record events that are specifically focused to be studied through this research. Video recordings for each student were

then analyzed. Interview in subsequent clinics are done to gather more information on some events and activities that the student has done.

The events are:

- Moves to a new node.
- Activate hot spots to retrieve information in the form additional text, graphics, animation, audio or video clips.
- Switch to the main menu.
- Move to concept map.
- Select a concept found in the concept map to learn.

Results and Discussion

Based on the objectives of the study, three categories of analysis were conducted, namely:

Phase 1

Implications of software development design

Table 1 and 2 showed the score obtained while observations were made and the duration of the interaction and the number of events that have been performed by the student concerned.

Obtained Scores of the Case Study

Table 1

Description of the attained scores of the sample learners

Learners	Scores
A	8/10
B	7/10
C	7/10
D	7/10
E	7/10
F	5/10

Table 2

Period of Interaction and Number of Events

Students	Interaction period	Bit. Events (minutes)
A	38	89
B	53	102
C	55	87
D	46	98
E	61	125
F	56	145

The above results showed that students have learning needs and strategies which vary from person to person. Some learners need interaction time longer and they require more information or activity compared with their counterparts. This may be related to a student's cognitive ability. To meet individual differences requirements, educational software might be developed flexible and suitable to fulfill the needs of the individuals. The flexibility might be adjustable as par the cognitive abilities of the learners.

Sequence analysis of the events taken from the observation of the learners through recorded videos showed that the learning trajectory that has been done by the students seemed complex and differed in interaction patterns. Individual differences were observed in this regard. Generally, there are two significant patterns that are a) structured patterns and b) unstructured patterns.

Present research dealt with the learning styles so, it was maintained to observe how learners attained information and then processed it cognitively. It was found that every individual learner obtained information differently and processing system of each learner also remained different. Every individual used different patterns of interaction with the software. Merrill, (2009) rightly observed that the learners should be given the freedom to control the sequence of events while learning (Merrill & West, 2009). This sequential learning provides them openness to variety of learning strategies. They can acquire learning skills according to their style and cognitive needs. To achieve this a software may have effective user control which may allow student to learn according to their own orientation (Kirschner, Sweller, & Clark, 2006).

The analysis of the interview identified that the learners liked the learning situations provided to them as it gave them complete freedom and they were able to determine the rate and style of learning on their own ways and means.

Findings through this research proved that, software developed through hypertext, hypermedia and simulation perspectives, are appropriate to provide a learning environment that has user control effective.

Phase 2

Design implications (Video Recording Sessions)

The video recording sessions disclosed that the learners who used the exploration tools, consisted of the main menus, icons, hot spots and concept maps for the exploration of information, explored concepts or

select new nodes, even with varying frequency (Rahman, 2017). It was also identified that the note, the use of interactive icons with the selection of appropriate graphics were found to be effective in highlighting information in animated, audio and video forms. It is evident when most animations and videos are represented with interactive icons seemed accessible to the learners.

Students with structured interaction patterns were found to move systematically in between nodes and it happens just because they were able to structure the knowledge in a suitable way. Students with a nonlinear style often use maps and concepts to move to a new node. They can view software content in overall way and select the concepts to learn. Concept maps are a tool for major exploration and necessary for them to structure their learning (Jo, Park, & Lee, 2017).

The results of the observations also showed that there was some important information already not accessible by the students in exploration. This showed that students needed guidance that gives a more detailed picture of what kind of information that is found in a node (Schiaffino, Garcia, & Amandi, 2008). The observations presented that the interface design of a software might be developed to display on the available options in the form of nodes. It is important to note that the software developers may develop software's which may help learners in developing exploration networks. Not only exploratory but also it may help the leaner in developing learning structures too.

Phase 3

Node types and student interactions (Observation design)

Observation of the nodes indicated that the nodes have degrees of high interactivity such as; experimental simulation nodes and physical phenomena nodes. These two nodes become the focus of the students. In the experimental simulation node, students can change variables, construct and test hypotheses. Since the learners have limited time to conduct learning activity on computer so these nodes may be developed as user friendly. A learner is influenced by external factors too, the use of computer simulations is an effective alternative to develop a concept through experiments (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014). Meanwhile, in the nodes of processes physically students can explore and discover an abstract phenomenon or dangerous through computers. Animation is used as a model to illustrate abstract processes while video clips give a true picture of a process which is dangerous or should not be shown in the classroom.

Teaching approach as this has given students the opportunity to study the phenomenon with more clearly and this has increased their interest and curiosity (Orcutt & Dringus, 2017). Generally, observations are made about student interactions with nodes which showed that software may be capable of inducing curiosity and provide a wide range of opportunities to build understanding in a variety of orientations. This will increase learner interest and motivation.

Summary of Results

The findings of the study were based upon the objectives. These findings were constructed on the observations, recorded videos and interviews from the learners. The findings stated that:

The learners may be given longer time to collect information about the learning interface. Every learner has individual mind and capacity for the cognition or result orientation. Some learners adopt or acquire learning quickly some are mediocre while some are slow learners. So, the time may be given as per their cognitive ability. This freedom of adoptability seemed to impact their sequential learning experiences. This learning experience provided them freedom to control sequential events in their learning experiences. In this process learners can easily learn the strategies of learning and they can acquire learning skills according their cognitive needs.

The interviews findings identified that learners liked to learn in situational learning. The cause behind this finding seemed that the learning situations provided them complete freedom and they were able to determine the rate and style of learning on their own. This learning session of free will provided them an opportunity to utilize their leisure time completely. In face to face classes they were unable to recapitulate the lecture while on media they were able to record and recall the sessions as they are readily available for them.

Sessions conducted while recording of the videos identified that the learners using exploratory tools were able to develop concepts. They attained new nodes and they were quick in their exploration and understanding of the concepts. The learning concepts illustrated with Audio Visual nodes were self-explained and easy to understand for the learners. It was found that those learners who worked with structured interaction patterns seemed to work systematically in between nodes and it was just because they were able to work according to their suitability. This happened because the nodes have greater degree of interactivity. A learner is influenced by external factors too; the use of computer

simulations is an effective alternative to develop a concept through experiments.

Conclusion

It may be concluded that multimedia education software should contain instruction in various forms such as text, graphics, audio and visuals but should also provide a learning environment which may provide learners with an ample opportunity to explore, discover and relate concepts to enable the learners to enhance knowledge, based on their own strategy and to satisfy the curiosity instinct within them.

Effective educational software should provide the widest possible opportunity to the learners at university level. The focus of software's should be to develop their knowledge structure. These software may have control over good user, has a high level of interactivity and is assisted by effective interface design. Software must also be able to increase motivation, encouraging taboos as well as encouraging exploration and exploration. This situation will lead to active learning and have expected learning productions through high effectiveness. There are many more aspects that need to be investigated and an effort may be made to develop quality software at local education level. Efforts may be made to obtain criteria that can be used as a reference to develop high quality local education software. One aspect may be kept in mind what needs to be studied in more depth is the aspect of the effectiveness of the interaction between users with computers and the factors that affect them. Lastly, development and research should be one of the focus of the field education to ensure the success of computer integration programs in education at our country.

It is recommended that the software developers of educational learning may try to meet the individual differences requirements; educational software might be flexible and suitable to fulfill the requirements of individuals. The flexibility might be adjustable as par the cognitive abilities of the learners. The flexibility might be adjustable as par the cognitive abilities of the learners. Software may have effective user control which may allow students to learn according to their own orientation. It is important to note that the software developers may develop software's which may help learners in developing exploration networks. Not only exploratory but also it may help the leaner in developing learning structures too. The learners should be given the freedom to control the sequence of events while learning. This sequential learning provides them openness to variety of learning strategies.

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