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Impact of 'OPTO QUEST'on Learner Motivation in a Constructivist Learning Environment

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ABSTRACT: *Since technology as a learning tool has recently come under increased scrutiny more focused attention has been directed to exactly what applications of technology will reap concrete benefits in learning. Hence in this research study the researcher intended to answer a research question within the given intent of evaluating the effect of a developed constructivist multimedia learning package named 'Opto quest' on learner motivation. 'Opto Quest' is a multimedia learning package designed on the basis of Mayer's multimedia learning principles, constructivist perspective and 5E instructional model developed by the researcher using ADDIE instructional design framework. The conceptual framework of the present study is defined by the proposition that the use of 'Opto Quest' has a positive effect on motivation. A comparative study on the level of motivation was analysed with the help of Keller's ARCS instrument. Results indicate that the group taught with the help of 'Opto Quest' shows a higher level of motivation than the group taught with conventional method. Based on these findings it is recommended that, when designing multimedia learning environments, the designer should consider incorporating the multimedia learning design principles and constructivist principles.*

KEYWORDS: *Conceptual Framework, Opto Quest, Motivation, Constructivist multimedia Learning Package*

I. INTRODUCTION

In the knowledge society of modern times, students are exposed to information in very different ways and the amount of information is rapidly increasing. What lay at the core of this explosion is the continually renewed efforts exerted for research and development purposes. While facilitating the development of individuals, it should also be ensured that people have the information, the attitude and are equipped with the skills, which are necessary for them to closely monitor contemporary developments, to make necessary adaptations in their life to become part of these developments and from the process gain experiences enabling them to construct new knowledge. Thus the knowledge generated will focus on the individual, to orient him towards globalization based on sociality, cooperation and team work which have become indispensable components of contemporary life. In this context, education systems, besides constantly developing to meet the needs of the current era, have been obliged to focus on the future. This has brought about the shift in emphasis in the concept of education from the age-old transfer of knowledge from teacher to student to the process of assisting students in acquiring the skills to access and use information.

In the world of multimedia learning, many research studies have been conducted that examine the process of multimedia development and the effect of multimedia learning in student achievement. However little research has been conducted regarding student performance in a constructivist multimedia learning environment and on study of effectiveness of environment on the student's motivation. According to Hede [1], the research on multimedia learning environments ranges from the highly positive to negative, with much of the research indicating no significant effect in either direction. At this time, in the development of multimedia instruction, there seems to be much debate as to whether multimedia affects motivation. One of the values of using multimedia learning environments is the ability to allow for a high level of student independence in the learning process and, therefore, the design instruction prefers to be grounded in a constructivist learning theory. Unfortunately, this has not been common practice, and instructional designers have tended to develop rigorously controlled learning environments built around specific objectives that lead to little discovery learning with little relation to constructivist learning theory. While ideally any sound learning theory suitable to the instructional content should have driven the design of the multimedia learning environment. But too often this has not been the case while in practice. Time management, difficulty, expense, and the lack of understanding of the relationship between learning theory and student performance have been the major hindrance to the application of these theories.

An autonomous multimedia learning environment based on constructivist learning theory may intrinsically motivate students who want to learn. Cooper [2] explained that constructivist learning theory is a problem-solving-based design utilizing discovery learning, in which the learner is intrinsically motivated toward the subject matter. Lepper & Chabay [3] reported that intrinsic motivation tends to promote student learning

strategies that demand more effort, and it assists students in processing information more deeply and clearly than extrinsic motivation. A constructivist design in a multimedia learning environment, in theory, may be able to modify the student attitude from aversion to one of interest in the subject and self- motivation to learn more.

The general purpose of the present study was to investigate the relationship between student motivation and instructional design. Specifically, the study sought to explore differences between an instructional design based on interactive multimedia learning environment grounded in constructivist theory (non-linear) as opposed to a design grounded in a more traditional, objectivist-based (linear) approach. This area of investigation is important because teachers may be able to better implement multimedia learning environments that foster student motivation and increase student performance in the classroom if they first know how multimedia learning environments assist in the learning process and impact student motivation, attitude toward learning, and memory retention. Thus, for researchers, the challenges include the need to pay particular attention to research design, development and analyses.For instructional designers and educators, the challenges include the need to select the most appropriate instructional, technological, and motivational methods to improve learning. This study dealt with some of these challenges.

II. CONCEPTUAL FRAMEWORK

Based on the three integrating themes: multimedia learning principles, constructivist perspective and 5E instructional model the conceptual framework for the study was constructed. Keeves & Sowden [4], emphasize that the conceptual or theoretical framework serves to describe and explain the major facets of an investigation. It also identifies the key factors and the assumed relationship between them. According to Miles & Huberman [5], a theoretical framework explains either graphically or in narrative form, the main things to be studied-the key factors and constructs of variables-and the presumed relationships between them. Keeves & Sowden [4] sum up, suggesting that a theoretical framework should use a diagrammatical rather than a narrative format; be successively revised; encourage the research work, comparing different visions; avoid a global level of generality ,focus and identify boundaries, and be capable of being proven wrong; and employ prior theorizing and previous empirical research for testing. In the context of the themes, multimedia learning principles, constructivist perspective and 5E instructional model, the main aim of the research study is to design and develop a multimedia learning package based on constructivist perspective for secondary school students. Fig.1below illustrates how the Conceptual Framework is used to derive the design framework for the study.

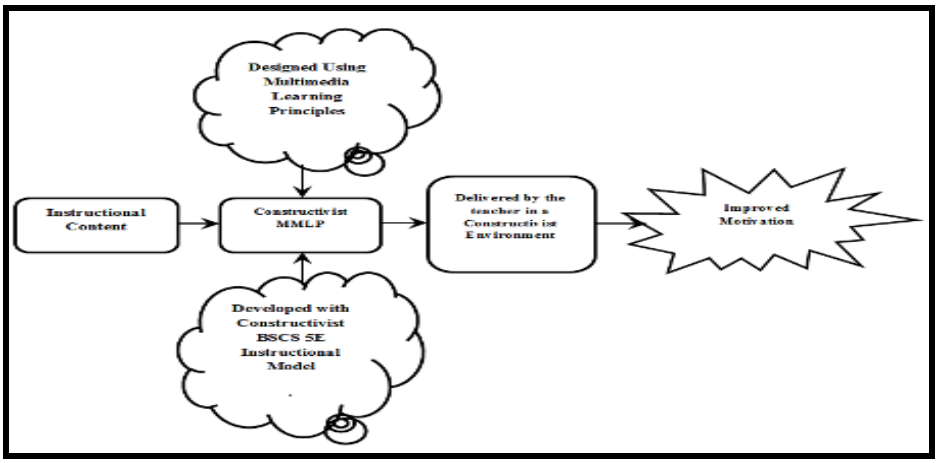

Fig.1 Conceptual Framework

The conceptual framework of the present study is defined by the proposition that the use of a constructivist multimedia learning package has a positive effect on motivation. Here the constructivist multimedia learning package with a specific instructional content is designed using Mayer's multimedia learning principles and developed with Constructivist BSCS 5E Instructional Model. The researcher here tries to integrate technological and constructivist principles into a pedagogically suited Multi-Media Learning Package.
It is evident from several studies that a mutualistic relationship exists between the technological environment and the constructivist perspective on learning. An increasing number of experts are extolling the virtues of modern technology as a tool for constructivism [6]; [7].Electronic technologies have unlimited capacity for finding information related to a question or concept, illustrating ideas in graphic and auditory forms, providing individual as well as group interaction on learning content. These are all tools that are vital to the process of understanding, organizing, and applying knowledge as the constructivists describe. This relationship promotes an increased level of motivation, knowledge construction and the development of social and communication skills among learners [8].

2.1 'Opto Quest'

The investigator here tries to design and develop a constructivist multimedia learning package based on the multimedia learning principles, constructivist perspective and 5E instructional model using an instructional design framework. An important requirement to create innovative interactive multimedia content is the correct use of instructional design. Instructional design represents a systematic, coherent approach to the design of computer-based instructional materials. Models for instructional design provide procedural frameworks for the systematic production of instruction.To create an innovative interactive multimedia application; a multimedia designer needs to rapidly explore numerous design ideas early in the design process, as creating an innovative design is the corner stone of creating an innovative multimedia learning platform. On reviewing the literature related to Cognitive theory and multimedia learning principles, Constructivist perspective of learning and 5E model, instructional design and ADDIE model, the investigator is trying to design and develop a multimedia learning package based on the integrated design principles derived from the multimedia learning principles, constructivist perspectives on learning and 5E model with the help of ADDIE instructional design model. The ADDIE(Analysis, Design, Development, Implementation, Evaluation) model adopted for this research study is possibly the best known design model[9],[10] and further this instructional design model is a practical generic model which is easily implemented [11], [12]. The ADDIE framework provides a sound base for the development of constructivist multimedia learning package where the developed Propositional Knowledge Statement (PKS) based on the topic 'Colours of Light' formed the specific content for the package. Hence in the present study the investigator named the developed constructivist multimedia learning package as '***OPTO QUEST'*** with due relevance to its content.

2.2 Motivation

Motivation is one of the most important psychological concepts in education [13], [14].It is a psychological attribute that entices students to learn as well as to complete learning activities [15]. Motivation is an essential factor to sustain learners' satisfaction in a constructivist learning environment. Lack of motivation can be a major obstacle that prevents learners from concentrating on an instruction [16].Maslow [17] defines motivation as a psychological process where a behavior is directed toward a goal based on an individual's needs. Keller [18] argues that although motivation is idiosyncratic, learner motivation can also be affected by external aspects. These factors include systematic instructional design of tactics and strategies intended to improve motivation and performance, as well as encouragement and support by instructors, tutors, or peers.

Keller [19] developed the ARCS Model, a four factor theory that measures individuals' levels of motivation. The first factor, attention, is a strategy for arousing and sustaining a learner's interest [15]. Mayer [20] indicates that the appropriate design of instructional material can assist in gaining the attention of learners. Keller [18] notes that rich graphics, colour, and animation, when used appropriately, can help improve learner motivation and performance. Visser,L [20] used greeting cards with graphics and personalized messages to gain and sustain learner attention. The second factor, relevance, is related to how well the instruction meets a learner's needs and goals. Course content not only must be current but needs to be aligned with course objectives. Learners need to perceive content as compatible with their learning preferences, consistent with personal learning goals, and connected to their prior experiences [21]. Instructional strategies should build connections between the instructional environment (e.g., content, teaching strategies, social organization, learning goals, etc.) and past experiences [22]. Wager [23] notes that it is also important to select the appropriate kinds of media and amounts of interactivity. Technology-based learning can provide rich opportunities for task-related simulations, practice, and customized feedback. Harrison [24] notes that when these capabilities are integrated to their full potential, they can enhance the learning process.

Confidence, the third factor, refers to the learner's attitude toward success or failure [25]. Keller [22] points out that the confidence factor incorporates variables that relate to students' feelings of personal control and expectancy for success. In general, the attitudes toward success can influence learners' learning efforts and performance. The last factor of the ARCS model is learner satisfaction. Satisfaction can be defined as positive feelings about students' learning experiences. Rodgers & Withrow-Thorton [13] believe learners need to be satisfied with the learning experience in order to maintain appropriate levels of motivation. Keller [26] identifies three kinds of tactics to improve learner satisfaction: (1) Intrinsic Reinforcement; (2) Extrinsic Rewards, and (3) Equity.

III. METHODS

3.1 Purpose and research questions

The primary purpose of the research study was to find whether 'Opto Quest' is effective for the enhancement of learner motivation of secondary school students as measured by Keller's ARCS instrument. Hence the research question is: *In applying the constructivist multimedia learning strategy in the given instructional context, will 'Opto Quest' have an effect on the learner motivation?*

3.2 Procedure

To test the effectiveness of "Opto Quest", various schools were identified.. The students of these schools were separated into two groups namely an experimental group and a control group. For the experiment, the lessons were taught in a short period of three weeks. The experimental group was taught with the help of the 'Opto Quest'. The developed package was encompassed in compact disc (CD). With help of CD and computer assistance the investigator covered the topics. The computer was attached to LCD projector and separate audio-visual hall was made available for this activity. The control group students were taught the same topics through conventional teaching method of explaining with occasional demonstration. At the end of the experiment, Course Interest Survey was administered to both the groups.

3.2.1 Instrument

The scale most appropriate for this research is the Course Interest Survey developed by Keller [27] and was used with permission for this study (J. Keller, e-mail communication, July 1, 2009).

The Course Interest Survey is a 34-item survey with a Likert-Type scale. Participants are asked to think about each statement in relation to the course itself, and to indicate how true each statement is. The response scale ranges from 1(Not True) to 5 (Very True).Therefore, the minimum score on the 34 item survey is 34,and the maximum is 170 with a midpoint of 102.The minimums, maximums and midpoints of each subscale vary because they do not all have the same number of items. There are 5 subscales, one for each of the ARCS components (Attention, Relevance, Confidence, Satisfaction) and one for the ARCS total score. Nine of the 34 items are reversed. There are no norms for the survey. As it is a situation specific measure there is no expectation of a normal distribution of responses. Scores are determined by summing the responses for each sub scale and the total scale. Items marked reverse are stated in a negative manner. The responses have to be reversed before they can be added into the response total. That is for the reverse items, 5=1, 4=2, 3=3, 2=4, 1=5. After obtaining permission from the author to use and modify the instrument, the instrument was slightly modified to assess how 'Opto Quest' affects learner motivation.

3.3 Data Analysis

After the data collection phase, Cronbach alpha coefficients were calculated to determine the instruments internal reliability. The instrument had a reliability coefficient of 0.95.The internal reliability estimates based on Cronbach's alpha, are attention (α=0.94), relevance (α=0.91), confidence (α=0.82), and satisfaction (α=0.92).An independent t test was conducted to measure differences in mean scores between experimental group and control group on all four factors.

IV. RESEARCH RESULTS

4.1Demographic Summary

All participants of the study were students of standard VIII of secondary schools of Kerala, India. These schools were located in places having different background, one in coastal area, one in hilly area and yet another in plane area. The three areas represent the cross section of Kerala. Hence the students of these schools form the representative sample of Kerala state. A sample of 168 students was taken for the study in each school of which half of them formed the one group and the other half formed another group. The groups were identified as follows: 1) Experimental group and 2) Control group. Demographic information about the participating students was collected and analyzed using general descriptive statistics. The table below displays the gender and mean age for each group.

Table 1 Gender and mean age of study participants

		Hilly Area		***Coastal Area***		***Plain Area***		***Total***	
Groups		Experimental	Control	Experimental	Control	Experimental	Control	Experimental	Control
Gender	**Female**	10	11	12	10	11	14	33	35
	Male	15	14	16	18	20	17	51	49
Mean age		13.2		13.4		13		13.2	

The age of the participants ranged between 13 and 14.

4.2 Research Question

In applying the constructivist multimedia learning strategy in the given instructional context, will 'Opto Quest' have an effect on the learner motivation?

Research Question examined the effect of 'Opto Quest' on motivation (measured by the Course Interest Survey (CIS) and their attention, relevance, confidence, and satisfaction sub scores).All students were asked to complete the CIS to assess their motivation as it related to their classroom environment. Differences in motivation were measured for those students who received conventional instruction (control group) versus those who received constructivist multimedia learning instruction (experimental group).

To analyze research question, mean vector scores of experimental and control groups were compared for the Course Interest Survey. Each sub score (for Attention, Relevance, Confidence and Satisfaction) was analyzed as a vector.

Table 2 Experimental Group CIS Mean Vector Scores

Dep. variable	*N*	*Mean*	*Standard deviation*
Attention	84	31.036	4.8
Relevance	84	33.357	5.25
Confidence	84	31.905	4.95
Satisfaction	84	33.702	5.52
Total	84	130	12.54

Table 3 Control Group CIS Mean Vector Scores

Dep. variable	*N*	*Mean*	*Standard deviation*
Attention	84	28.71	6.36
Relevance	84	29.75	7.37
Confidence	84	28.19	6.35
Satisfaction	84	28.14	6.72
Total	84	114.80	19.76

A graph showing comparison of Mean ARCS Scores on Course Interest Survey is shown below.

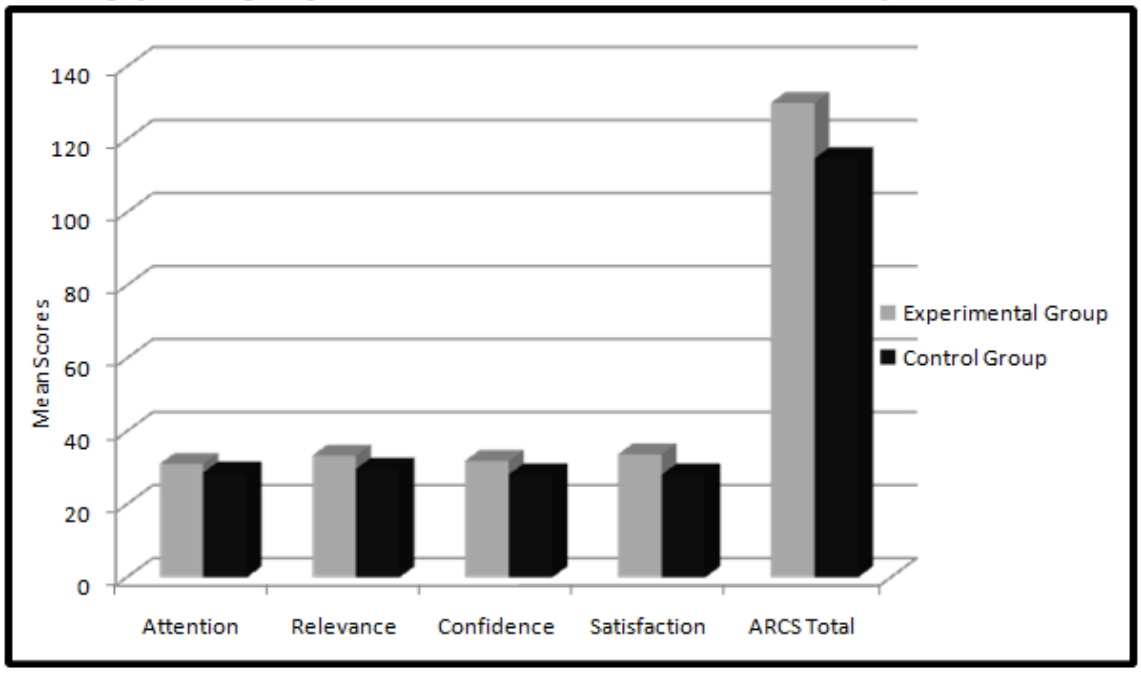

Fig.2 Comparison of Mean ARCS Scores on Course Interest Survey

For the data analysis the scores obtained for the experimental group and control group are subjected to test of significance of difference between uncorrelated means using a two-tailed test. The details of analysis are given in the table below.

Table 4 Test of Significance of the Difference between Mean Vector Scores of Experimental and Control Group.

Vectors	Groups	Standard Deviation	Critical Ratio	Level of Significance
Attention	Experimental	4.8	2.67	Significant at 0.01 level
	Control	6.36		
Relevance	Experimental	5.25	3.65	Significant at 0.01 level
	Control	7.37		
Confidence	Experimental	4.95	4.23	Significant at 0.01 level
	Control	6.35		
Satisfaction	Experimental	5.52	5.86	Significant at 0.01 level
	Control	6.72		
Total	Experimental	12.54	5.95	Significant at 0.01 level
	Control	19.76		

The critical ratio of the test for attention of the experimental group and the control group is found to be 2.67, which is significant at 0.01 levels. Hence from this result we can understand that the two groups differ significantly in attention .Since the mean score of the experimental group is greater than that of the control group for the vector attention, the experimental group is superior to the control group. Hence it can be concluded that the experimental group who were taught in a constructivist multimedia learning environment with the help of 'Opto Quest' create an attention much more than that of control group.

The critical ratio of the test for the vector relevance of the experimental group and the control group is found to be3.65, which is significant at 0.01 levels. Hence this result shows that the two groups differ significantly in the vector relevance. Since the mean score of the experimental group is greater than that of the control group for the vector relevance, the experimental group is superior to the control group.

The critical ratio of the test for confidence of the experimental group and the control group is found to be 4.23, which is significant at 0.01 levels. From this result we can understand that the two groups differ significantly in confidence. Since the mean score of the experimental group is greater than that of the control group for the vector confidence, the experimental group is superior to the control group. Hence it can be concluded that the experimental group who were taught in a constructivist multimedia learning environment with the help of 'Opto Quest' is more confident than control group.

The critical ratio of the test for satisfaction of the experimental group and the control group is found to be 5.86, which is significant at 0.01 level. Hence from this result we can understand that the two groups differ significantly in confidence. Since the mean score of the experimental group is greater than that of the control group for the vector satisfaction, the experimental group is superior to the control group. So it can be concluded that the experimental group who were taught in a constructivist multimedia learning environment with the help of 'Opto Quest' create satisfaction much more than that of control group.

The critical ratio of the test for total vector scores which represent the score for motivation of the experimental group and the control group is found to be 5.95, which is significant at 0.01 levels. Hence from this result we can understand that the two groups differ significantly in motivation. Since the mean score of the experimental group is greater than that of the control group for the total vector score motivation, the experimental group is superior to the control group. Hence it can be concluded that the experimental group who were taught in a constructivist multimedia learning environment with the help of 'Opto Quest' get more motivated than that of control group. That is the students in the treatment group have greater levels of motivation.

V. DISCUSSION

The research question examined the effect of 'Opto Quest' on motivation in the learning process as measured by the Course Interest Survey and its ARCS sub scores. Results showed that students in the treatment group had significantly higher levels of motivation than control group students. Further, all of the attention, relevance, confidence, and satisfactions sub scores revealed significantly higher levels of motivation among treatment group students. The study by Korakakis, G. et al [28] indicate that multimedia applications with interactive 3D animations as well as with 3D animations do in fact increase the interest of students and make the material more appealing to them .The research results that provide the enhancement of motivation through multimedia learning packages include studies of Krishnasamy [29] , Neo & Neo [30], bin Mohamad et al [31], Barak et al [32]. Their findings support the positive effect of multimedia constructivist environment on motivation towards learning.

Several findings confirmed that motivation is one of the most critical concerns in how and why people learn [33], [34], [35]. Their findings confirm previous research finding that suggest that motivation plays a critical role in performance [36].Also, despite the idiosyncratic nature of motivation, external factors can have a positive effect on learners. Therefore, improved performance can be expected to occur if motivational design is included in the development of multimedia learning materials.

Thus, as far as the effect of 'Opto Quest' based on multimedia learning principles and the constructivist 5E model was concerned, it definitely enhances the motivation towards learning and thereby improves the academic performance of secondary school students. Hence this study clearly supports the skillful use of 'Opto Quest in secondary school classrooms to enhance motivation and thereby the academic performance of students.

VI. CONCLUSION

The results of this research supported the theory that a constructivist multimedia learning package can enhance learner motivation. This study also shows that a pedagogically well designed constructivist multimedia learning package can enhance motivation towards learning. Based on these findings it is recommended that, when designing multimedia learning environments, the designer should consider incorporating the multimedia learning design principles and constructivist principles. The designers should also take into consideration the learning style of learners. The multimedia developers should try to follow an instructional design while developing multimedia learning packages.

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