Effectiveness of a Constructivistic Multimedia-Learning Package on Shaping and Guiding Students' Attitudes Toward Physics

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ABSTRACT

Physics is considered by some to be the most perplexing area in the sciences and perceived as a hard subject for students from secondary school to the university to adult-graduate education. Educational research has provided evidence that attitudes towards physics change with exposure to it. When students have negative attitudes towards physics, they often do not "like" physics courses or the teachers of those courses. Based on this premise, numerous studies have been conducted to determine the factors that affect students' attitudes towards physics. A goal that is important to most if not all teachers of physics courses is to inspire students to have a positive attitude towards the subject. This goal encompasses an appreciation of how physicists think and how they incorporate the values that it provides, as well as, how it is applied to other areas or related fields, and its application in everyday life. In this regard, the aim of this investigation has been to explore how to impact more effectively positive students' attitudes in physics courses. To that end, we report the effectiveness of a constructivistic multimedia-learning package (MLP) in shaping and guiding students' attitudes towards physics.

Keywords: Constructivist, Multi-media Learning Package (MLP), Cognition, Bloom's Affective Domain

1. INTRODUCTION

For almost a century, the question that existed in educational technology research was that of which medium could most effectively deliver knowledge. Educators and researchers have worked hard to show that technology, as a tool, not only can assist the delivery of information in learning, but can improve learning as well. It was during the last few decades that these groups have begun to embrace the constructivist paradigm in contrast to using only objectivistic methods. It has been argued that constructivism can provide the foundation that guides the application of technology towards more intellectual instructions. Moreover, it provides a theory of learning based on the learner's processing of information and holds promise of achieving two perennial instructional goals: the differentiation of learning tasks and the shifting of the responsibility for learning to the learner.

In this regard, learning is not just a mechanical process, and for this reason, more care must be taken when designing and implementing technological teaching tools. The dominant missing feature in the vast majority of educational technology research is a lack of an appropriate theoretical foundation. Researchers have had the misconception that students could be receptors of knowledge rather than active learners. This led to studies that searched for a better vehicle for conveying knowledge, ignoring the affective and cognitive domains, as illustrated by Blooms' taxonomies [1]. In light of this fallacy, the goal of research is changing. Researchers are examining learning with technology from the ground up, seeking to understand the fundamental "active ingredients" to progress scientifically to "authentic educational learning technologies" [2]. In this context, the process of design and development of effective interactive multimedia learning materials, especially for engaging the learner, needs to be guided by an academic framework based on relevant theories. This matter could be tactfully addressed by applying a conceptual framework of principles of multimedia learning and constructivist learning theories to the pedagogical design of learning material.

Although many studies have stated that the Affective Domain is importance, it is the least studied, often being overlooked, and the most nebulous and the hardest to evaluate. The reason for this outcome is that research paradigms in social psychology and educational psychology, which influenced research in science education, shifted from a behavioral to a more cognitive orientation [3]. Usually, in classroom instruction, the teacher's efforts go immediately to this aspect of teaching and learning, and most of the classroom interaction is designed for strengthening cognition, which is more suitable to well prepared students [4]. Moreover, evaluating cognitive learning is straightforward, but assessing affective domain influences is less direct and more difficult to implement. A contemporary view is that the "affective dimension" is not just a simple catalyst, but it is a necessary condition for cognitive learning to occur [5]. Thus, there is significance in realizing the potential to increase student learning by tapping into the Affective Domain, especially regarding students' attitudes pertaining to valuing knowledge, and the process of receiving it.

As far as we can determine, no ready-made courseware designed in a constructivistic environment exists in the Indian Education System. This is a critical feature since India is the initial location of this investigation. In India, the observed courseware, provided by various governmental and non-governmental agencies, is generally based on the objectivistic model. There might be some constructivistic elements embedded within a given courseware, but for the most part, it is designed in an objectivist manner. In this regard, since classroom teachers typically do not have the resources, time or expertise to prepare their own courseware based on the constructivistic methods, it has become imperative to ensure that ready-made courseware is available to schools to assist teachers in implementing teaching and learning processes in this manner. Upon realizing this need, we have ventured into the challenging process of developing a Multimedia-Learning Package (MLP) that uses both constructivism and multimedia learning principles. From envisaging the scope and the importance of MLP, the first author of this study has designed and developed such a package, under the name **"Opto Quest,"** which is based on integrated design principles as derived from Mayer's multimedia learning principles [6].

2. THE DESIGN AND DEVELOPMENT OF OPTO QUEST

The impact of constructivism on classroom practices has been studied by many researchers [7-9], and others have suggested that constructivist strategies can exploit technologies for the greatest impact in learning [10]. To that extent, a symbiotic relationship appears to exist between computer technologies and constructivism.

Although constructivist theory has been implemented with several instructional models, the most commonly used model has been the 5E model, with 5E expressing *engagement, exploration, explanation, elaboration and evaluation*. This model was developed by a team led by Roger Bybee [11], and was designed primarily by science educators for secondary science teaching when using a classic constructivist structure with a convenient format. In their study, Keser and Akdeniz [12] stated that the 5E model was one of the best-known models among the ones that were recommended for constructivist learning theory. The model encourages students to formulate their own concepts, and provides a tangible reference for teachers to use their expertise in structuring a learning environment, which will facilitate students' interaction within a learning context in a critical, reflective and analytical way [13, 14].

Based on the three themes, which were multimedia-learning principles, constructivist perspective and 5E instructional model, we have integrated a conceptual framework for this MLP. This learning package, with a specific instructional content based upon the theme "Colors of light" from a Physics subject, has been designed using Mayer's multimedia-learning principles and developed with the Constructivist BSCS 5E Instructional Model. Thus, we have integrated technological and constructivist principles into a pedagogically suited MLP.

3. PURPOSE OF THE STUDY AND RESEARCH QUESTION

For decades, science educators have been interested in understanding how students achieve in academia. Such research has revealed that there is a strong association between science achievement and attitude towards science [15, 16]. In TIMSS 1999 (Trends In International Mathematics and Science Study 1999) and the International Science Report [13], students' attitude towards science was one of the ways to elicit information that could provide an educational context for interpreting science achievement results. According to educational psychologists, the attitudes of students play an important role in their systematic and scientific training. While Gardner has described science-related attitudes as learned tendencies to evaluate objects, people, events, and situations in a specific way or a set of propositions related to science, Martinez, in his studies that were aimed at determining the effects of attitudes on science education, has put forward the notion that students' attitudes towards science lessons affect their academic achievement and the tendency to continue in the sciences [17]. Moreover, the measurement procedure of students' attitudes towards physics should take into account their attitudes toward the learning environment [18]. The affective aspect of students' attitude toward science is incredibly significant, since problem solving requires patience, persistence, and a willingness to accept risks [19], which are innately associated with attitude. Hence, in this study, it is important to monitor students' attitude and ascertain whether or not the constructive MLP has the desired effect.

Since in this study, which was intended to answer the basic question of evaluating the effectiveness of a developed constructivist multimedia-learning package on students' attitude towards physics, we have addressed the following question:

> *In applying the constructivist multimedia-learning package in the given instructional context to secondary students, will Opto Quest affect the students' attitudes towards Physics?*

4. METHODOLOGY

The purpose of this study was to explore the effects of a constructivist MLP for secondary students. A Pre-test/Post-test Non-equivalent experimental-control group design was used in this study, and it was conducted with non-equivalent intact classroom groups. The experimental and control groups can be described as non-randomized. Both groups took the pre-test and the post-test, but only the experimental group received the instructional treatment. The sample for the study consisted of 168 students of secondary schools in India. In each school, the selected students were divided into two groups as Control group and Experimental group.

5. INSTRUMENT

In this study, a Physics Attitude Scale was developed and applied to identify students' attitudes towards physics. After reviewing many related studies about students' attitudes towards physics, selected dimensions, as they have been labeled, have been used, such as real-world connections, personal interest, sense making**,** conceptual understanding**,** and problem solving. The scale was constructed by making use of Likert's methods [20] of summation to obtain a five-point judgment on each item. Against each statement, five alternative responses, namely, "Strongly Agree" (SA), "Agree" (A), "Undecided" (U), "Disagree" (D) and "Strongly Disagree" (SD) were provided, with weights of 5, 4, 3, 2, 1, respectively in the order of their favorable to unfavorable statements, in a reversed scoring manner. Both positive as well as negative questions were included. Approximately six questions were related to real world connections, which included questions, such as, "I feel surprised while learning physical phenomena." Similarly, an equal number of questions were included under personal interest, such as, "I feel helpless while studying Physics." The questions like "I try to find the answers of natural phenomena related to properties of light," are included for focusing problem solving. Both positive as well as negative questions were included. About six questions were related to real world connections, which included questions, such as, "I feel surprised while learning physical phenomena." Moreover, an equal number of questions were included under personal interest, such as, "I feel helpless while studying Physics." Questions like "I try to find the answers of natural phenomena related to properties of light," are included for focusing problem solving.

After constructing the Physics attitude scale, a pilot test was conducted. Items analyzed were executed by calculating the discrimination index. The final draft of the Physics attitude scale consisted of thirty items covering five dimensions. The scale contained 30 statements, which represented the universe of items with content validity. The study employed split-half method to determine the coefficient of internal consistency, of which the reliability of the split-half test was found to be 0.78 using Spearman – Brown prophecy formula [21].

6. DATA ANALYSIS PROCEDURES

To analyse the research question, data were considered using Analysis of Covariance. The research question examined the effect of constructivist multimedia-learning strategy with the help of 'Opto Quest' on students' attitudes towards physics. The following hypothesis was suggested:

H_1: *The attitude of students towards Physics taught using Opto Quest is significantly higher than that of students taught without Opto Quest.*

The relationship between the physics attitude score of the experimental group for whom the lesson was treated with the help of constructivist multimedia-learning package and the control group of students where it was not used is shown below. Specifically, the pre-test and post-test Physics attitude scores of the students in the experimental and control groups are shown in the Figure 1.

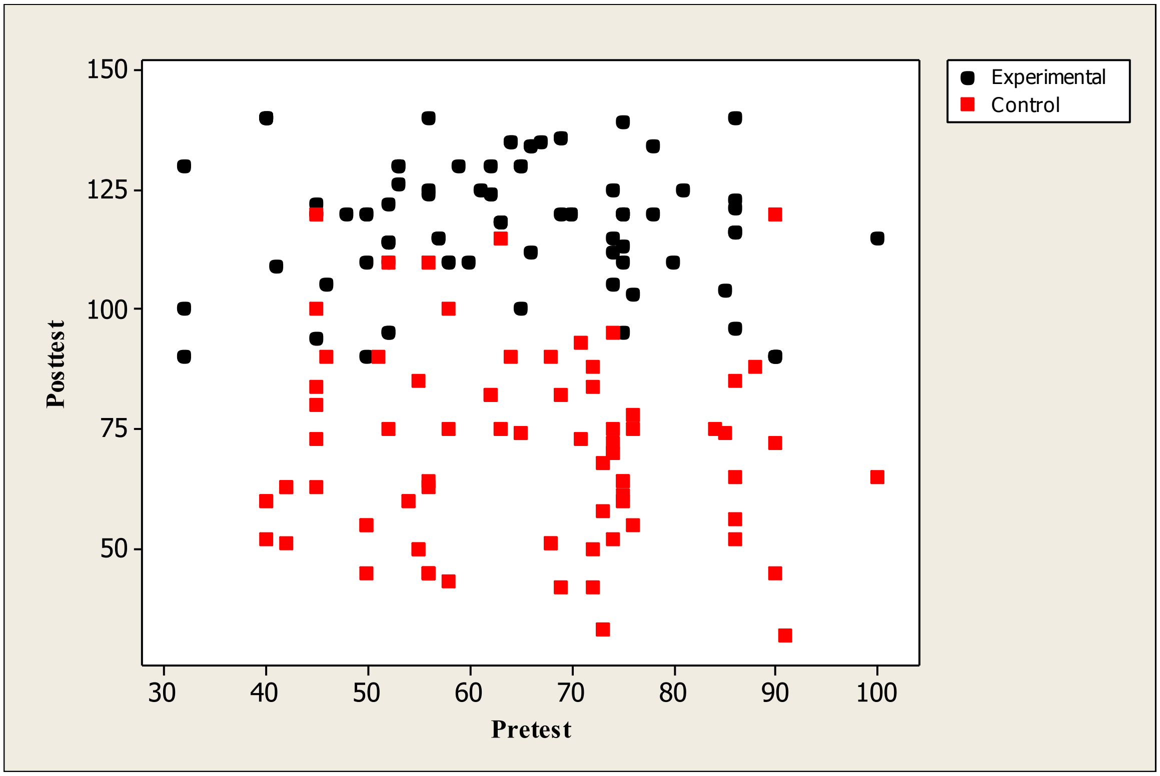

Figure 1: Scatterplot of Experimental Versus Control Group.

Figure 1 shows a bivariate distribution in the pre-test and post-test Physics attitude scores of the students in the experimental and control group study. From the graph, we can observe that attitude of students towards Physics taught using Opto Quest is significantly higher than that of students taught without Opto Quest. The experimental group consistently scored better on the post-test than the control group. Even though the control group had a 1.6 points pre-test advantage on the average, the experimental group scored 48.5 points higher on the post-test. Thus, applying the constructivist multimedia-learning package in the given instructional context improved students' attitudes toward Physics in this regard.

Figure 2 displays the pre-post means of the experimental group joined with a blue line (upper line) and the pre-post means of the control group joined with a yellow line (lower line). In this bivariate plot, given below, we observe quite clearly the original pre-test difference of 1.6 points, and the larger 48.5 point post-test difference. The plot gives a “cross-over" pattern. Here, the control group doesn't appear to change from pre-test to post-test, but the experimental group does, starting out lower than the control group and ending higher. This is the clearest pattern of evidence for the effectiveness of applying the constructivist multimedia-learning package in the given instructional context.

Analysis of Covariance (ANCOVA) has been used to analyze the pre-test and post-test physics attitude scores. In this analysis, we considered three scores for each student: a pre-test score (X), a post-test score (Y) and either a 0 or 1 to indicate whether the student was in the experimental (Z=1) or control (Z=0) group. In the statistical analysis of the non-equivalent group design, we needed to adjust the pre-test distribution for measurement error. The adjusted pre-test scores were given by:

$$X_{adj} = \bar{X} + r(X - \bar{X})$$

where, X_{adj} = adjusted pre-test value

$\bar{X}$ = original mean pre-test value

X = original pre-test value

r = reliability

The reliability analysis showed that the Cronbach's Alpha was 0.495, i.e., r = 0.495. The ANCOVA model is given by:

$$y_i = \beta_0 + \beta_1 X_{i-adj} + \beta_2 Z_i + \varepsilon_i$$

where, y_i = post-test score for the i^{th} unit

β_0 = Intercept coefficient

β_1 = Pre-test coefficient

β_2 = Group coefficient

$X_{i\text{-adj}}$ = Adjusted pre-test score

Z_i = Dummy variable for group and ε_i = error for i^{th} unit

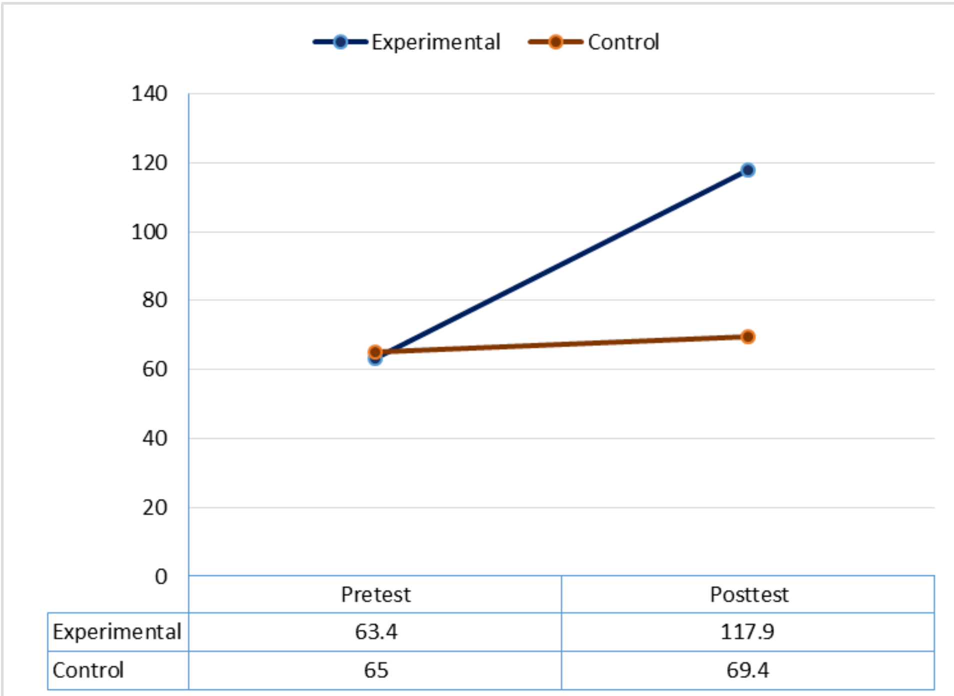

Figure 2: Pre-Post Means Of Experimental and Control Groups.

Tables 1, 2 and 3 give the ANCOVA analysis and parameter estimates for this model. From the analysis, we can observe that the procedure had a significant effect on the average experimental group, being 48.283 points, which is significantly higher than the control group. Thus from the statistical analysis, we conclude that teaching with constructivist multimedia learning package is more effective for enhancing students' attitudes towards Physics in this study.

Table 1: Levene's Test of Equality of Error Variances

Dependent Variable: Post-test

F	df1	df2	Sig.
11.695	1	166	.001

7. DISCUSSION & CONCLUSION

Our research question examined the effect of Opto Quest in enhancing students' attitudes towards Physics. Results showed a significant enhancement in the attitudes towards Physics for the students who were taught with the use of Opto Quest. The result describes some helpful approaches to the incorporation of computer-based multimedia teaching by utilizing constructivist design principles to facilitate the students' understanding and their attitudes towards learning physics.

The results of this study support the use of a constructivist multimedia-learning design in enhancing students' attitudes towards physics and hence can provide an increased academic performance in physics at the secondary level in India. It shows that a pedagogically well-designed constructivist multimedia-learning package can enhance attitudes towards physics, thus increasing problem-solving and collaborative skills as well as creative and critical-thinking abilities.

The limitations of the study and the researchers' reflections yield a suggestion for performing a replication of this study in the USA and using this approach in General Studies Level college courses, such as in Physical Science I, II, and the use of constructivism can have positives impacts in computer technology supplemental learning, through DVDs and Webcast learning.

Table 2: Tests of Between-Subjects Effects

Dependent Variable: Post-test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	98710.065[a]	2	49355.033	171.957	.000	.676
Intercept	23381.568	1	23381.568	81.463	.000	.331
Pretest-adj	254.774	1	254.774	.888	.347	.005
Group	97628.111	1	97628.111	340.145	.000	.673
Error	47358.214	165	287.019			
Total	1619445.000	168				
Corrected Total	146068.280	167				

a. R Squared = .676 (Adjusted R Squared = .672)

Table 3: Parameter Estimates

Dependent Variable: Post-test

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	80.344	11.720	6.855	.000	57.204	103.484	.222
Pre-test-adj	-.169	.179	-.942	.347	-.522	.185	.005
Group	48.283	2.618 .	18.443 .	.000 .	43.114 .	53.452 .	.673 .

ACKNOWLEDEMENTS

The authors thank NSF MSP APEX grant #1238192, and NSF RISE grant HRD #1546965 for partial support of this research. Furthermore, they thank the Physics Department at Alabama A&M University for its assistance with establishing a collaborative relationship between the authors.

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THIRAKALKKIPPURAM

Thanks

Dr. Usha Kumari
Dr. Divya C Senan

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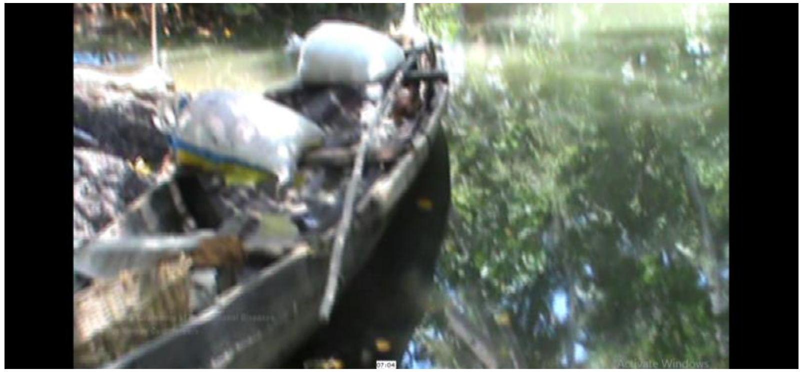
HEALTH LITERACY MULTIMEDIA PACKAGE (HLMP)



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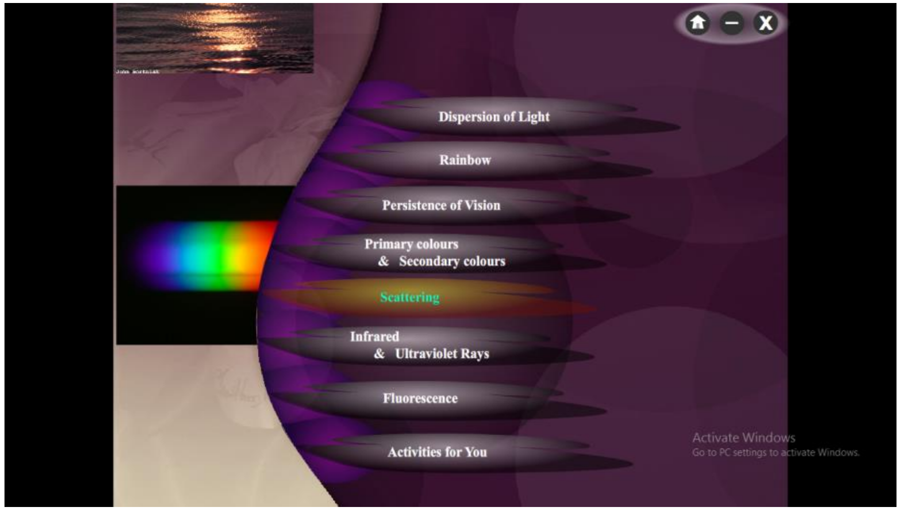
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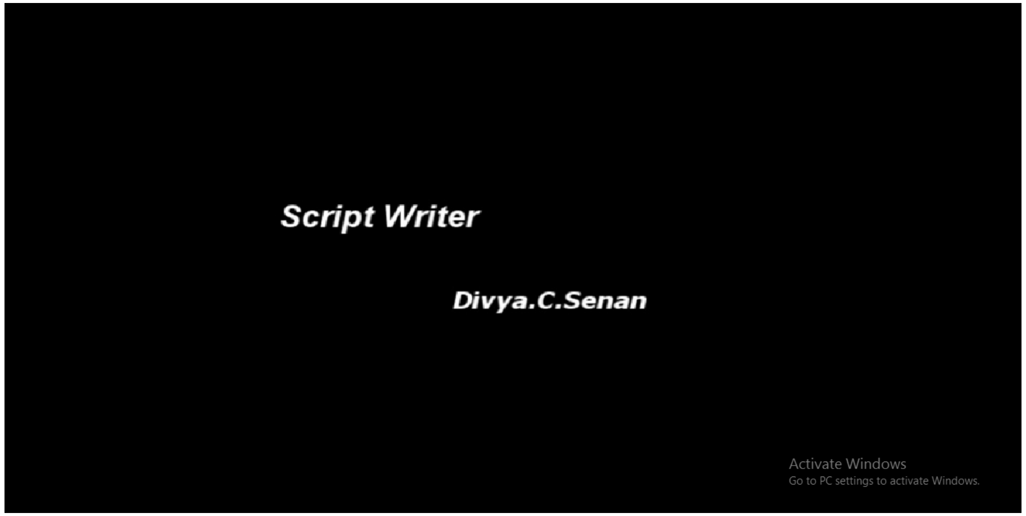
Script Writer
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No. 45545/2019/UOK Dated: 23.06.2020

From

The Registrar(i/c)

To

The Head,
Department of Education
University of Kerala

Madam,

Sub:- Collaboration with 'The Earth Foundation' for the Global Climate Education Month - 2019 Programme - Request for Permission – reg.

Ref:- Item No. 11.44 D1 of the minutes of the meeting of the Syndicate held on 15.05.2020.

With reference to the above , permission has been granted for the conduct of Global Climate Education Month - 2019 programme in collaboration with 'The Earth (Empowering Awakening Resilient Thinkers) Foundation and Climate hood' subject to the condition that there will be no financial commitment to the University and also should conform to the guidelines issued by the Govt. with respect to the COVID - 19 epidemic management .

Yours faithfully
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Chen, W. et al. (Eds.) (2016). Proceedings of the 24th International Conference on Computers in Education. India: Asia-Pacific Society for Computers in Education

Examining Students' Perception of Using Crowdsourcing based Mobile Apps for Environmental Education and Research Experiences.

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Abstract: In the context of complex environmental problems facing societies, it is desirable to enhance public awareness of environmental issues. In response to this challenge, environmental education is an integral part of curriculum utilized at all levels of education, including university education. Environmental education (EE) is now considered to be the most prominent instrument to influence human behaviour towards more environmentally sustainable patterns. However, it is often criticized for being reductionist and empirical and thus not optimal for training next generation of students who are expected to formulate solutions to complex, interdisciplinary environmental issues. We propose that new technologies (crowdsourcing apps) that are being used in research settings to solve interdisciplinary problems may also be used for experiential learning of environmental science. New technologies and growth of digital media are profoundly affecting today's university students. So, in view of the pervasiveness of new mobile technologies in today's life and learning, it is essential to lead the instructional process with integrating mobile technology in developing students' educational and research experiences. In so doing successfully, it is imperative to know the perception of students who are the real and prime users and beneficiary of such approach. Henceforth, the centre of attention of this paper is to investigate university students' perception and effectiveness of a crowdsourcing based mobile App for environmental education and research. The specific topic considered is land use and land cover change due to human activity. The students were provided with hands on 'experience of the Land Use Land Cover mobile application. Survey method was used to collect the data. The study reports that the students have a positive perception regarding the use of mobile application, based on the Open Data Kit (ODK), along with the Google Earth Engine (GEE) in implementing experiential learning approach for environmental education and research.

Keywords: Crowd sourcing, Mobile Application, Environmental Education and Research App, Experiential Learning

1. Introduction

Integration of Mobile learning technologies into educational setting settings is still in its infancy, and the development of new models, methods, systems and applications are needed to be put in place for successful integration. Teachers need to re-blend the present learning environment in higher education to ensure an efficient and effective mobile learning environment. The rapidly advancing mobile computing technologies along with abundant mobile software applications make ubiquitous mobile learning possible (Johnson, Adams, & Cummins, 2012). The innovation in mobile apps has raised interests among educators because it facilitates teaching and learning (Johnson et al., 2012). Apps are being developed at a rapid speed and are intensively used by students. Apps can be easily downloaded and used on a mobile phone device. Today's learners as digitally literate, 'always on' always connected and reachable. They want to stay connected and be reachable, they also want to experiment and have community oriented personalities and characteristics (Oblinger et al., 2005) They are collaborative and multitasking learners who like to study in a group-based environment (McMahon, M. et al 2005). Why can't we take this opportunity to use the technology to improve student's collaboration, and interaction thus making the learning environment effective, fun and challenging?

Mobile Apps for teaching and learning are breakthrough technologies in recent years, and teachers should use them and apply their methods to this effective learning environment. They should acknowledge that mobile phones along with educational and communicational Apps can be an efficient learning tool if integrated properly within the currently used settings at universities, as this could enhance teaching and feedback, thus simplifying the learning process for students, by providing experiential learning. Universities should implement this type of mobile learning environments and technologies and encourage students to use it and integrate it into the curriculum. It may create a learning environment that matches and fits today's digital learner's life style and improves their access to learning content, and makes the learning process, creative, collaborative and challenging. It is high time for universities and educators to re-design and revamp the forms of education according to the changing dynamics of today's learners, thus providing strategic solutions to various existing problems. The application of mobile learning technologies will potentially place universities at the forefront of pedagogical practice and addresses learners needs for flexibility and portability, as mobile learning and its Apps are considered the real authentic, ultimate anywhere, anytime, on demand and with any device, learning experience.

Behind this 'practical axioms' of learning prospect, this study aims at:

1. exploring Teacher Educators' 'perception' about crowd sourcing based mobile application in environmental education and research experiences
2. examining students' expectations of mobile application use in experiential learning;
3. developing an up-to-date crowd sourcing based mobile apps mediated environmental curricula; and
4. Preparing & equipping learners as workers and citizens in an information centric society.

2. Background

Environmental education should encourage children to become good stewards and to think globally but act locally regarding the environment and environmental issues. Environmental education is an invaluable tool for teaching critical thinking skills and applying these skills to the students' everyday world. The ultimate goal for environmental education is to create environmentally literate global citizens (Disinger & Roth, 1992). In order to accomplish this, educators must help students acquire a better understanding of their environment and natural resources as well as environmental issues affecting them. Educators can enhance children's explorations by providing them with interesting and enriching experiences that help them to explore outside of their direct environment and make connections and inferences within and between different phenomena in the environment. We create meaningful learning experiences when we help children to move beyond simple observations to more complex activities that require higher-level thinking and collaboration with peers (Jana Willis &Brenda Weiser, 2014).The power of Environmental Education and experiential education acting together is recognized by workers in the field. Thus using an experience-based approach to an environmental topic invites students to examine their own effects on the environment, whether positive or negative. We propose that new technologies (crowdsourcing apps) that are being used in research settings to solve interdisciplinary problems may also be used for experiential learning of environmental science. New technologies and growth of digital media are profoundly affecting today's university students. So, in view of the pervasiveness of new mobile technologies in today's life and learning, it is essential to lead the instructional process with integrating mobile technology in developing students' educational and research experiences. In so doing successfully, it is imperative to know the perception of students who are the real and prime users and beneficiary of such approach. Henceforth, the centre of attention of this paper is to investigate university students' perception and effectiveness of a crowdsourcing based mobile App for environmental education and research.

3. Crowdsourcing based Mobile Applications

It was with the development of web 2.0 4 that several technological trends and movements appeared: open data, big data and crowdsourcing. The proliferation of smart phones has paved the way for Apps that use crowdsourcing to gather their data. The wide availability of smart phones now makes it easier than ever to devote them to data gathering, with or without actual human intervention. The rapidly growing capabilities (sensors, hardware, software, social networking) of smart phones and tablets, coupled with their portability and accessibility, make them one of the most impactful ICTs in the world today. One of the most exciting developments made possible by the rapid spread of mobile technology is crowdsourcing. By engaging citizen scientists in spatially and temporally distributed measurements of processes, a significant yet inexpensive stream of useful information can be generated. There is clear and accelerated progress in the application of mobile technologies in support of crowd sourcing. Crowdsourcing apps are changing everything from the way we travel, to the way we work, to the way we gather information.

This study reports on the perception of university students regarding the efficacy of a mobile application **-** Public Environmental Education and Research App (PEERA), based on the Open Data Kit (ODK), along with the Google Earth Engine (GEE) to implement experiential learning approach for environmental education and research. The app functioning relies on open data and crowd sourcing.

4. PEERA: Public Environmental Education and Research App

A mobile application (Android platform), based on the Open Data Kit (ODK), for populating a Google Earth Engine based Land Use Land Cover ground truth database is developed. The ODK (Open Data Kit) is a set of tools that allows data collection using mobile devices and data submission to an online server, even without an internet connection or mobile carrier service at the time of data collection. The Open Data Kit (ODK) based application is intended for crowd sourcing of ground truth information regarding the nature of Land Use and Land Cover (LULC). The LULC ground truth data, in conjunction with algorithms and Land sat satellite imagery available through Google Earth Engine (GEE), will provide community based organizations the capability to generate LULC maps with relative ease.

Figure 1: Screenshot showing the home page of PEERA user module

In an experiential learning approach the App is used to collect first-hand information regarding land use and land cover upon which the students can reflect and form concepts to solve environmental issues. When the class starts, the teacher can purposefully pose a problem or issue in front of the students for them to solve. She/he should decide what the students should learn or gain from the learning experience. Effective educational interventions should provide pupils with the kind of education that appeals to and has a personal meaning for them. It is most probable that we do not learn anything unless we have a clear personal motive for doing so (Rogers, 1957), i.e. unless it is connected to our personal experiences. A question of the kind "How is your neighbourhood changing"? can be posed to the students. Once begun, the facilitator should refrain from providing students with all of the content and information and complete answers to their questions. Instead, guide students through the process of finding and determining solutions for themselves.

Now the students can go out of their classrooms and use the mobile application to collect a sample of geo-locations for different land cover types. Here the learner will be undergoing the concrete experience which emphasizes personal involvement in everyday situations. In this stage, the learner would tend to rely more on feelings than on a systematic approach to problems and situations. Students perform a hands-on minds-on experience with little or no help from the instructor. They collect three or four ground truth data and upload it to the server. Now the students can visualize the collected data in a fusion table and will discuss their experiences as a group. Discussions will focus on their thoughts and will provide differing views on the topic. In the classroom, reflection can take the form of an individual activity, within small groups, or with the entire class. Children construct an understanding of the world around them, and then experience discrepancies between what they already know and what they discover in their environment. Students analyze the generated satellite imagery and construct conceptual understanding that integrates one's observations into logically sound theories. They classify satellite imagery and understand how their neighbourhood has changed over the years. They can visually see how urban regions grow, crop lands shrink and forests disappear. In the last phase students generate solutions to make decisions or to solve real life problems.

4. Methodology

4.1. Research Context and Participants

The study was conducted in university of Kerala .The participants of this study were M.Ed students M.Phil students and Research Scholars of Department of Education. They were chosen on random basis. A total of 52 students took part in this study

4.2. Data Collection Procedure & Questionnaire

Survey methodology was facilitated through the use of a one page written research questionnaire for this study. The questionnaire was given to the sample after conducting a workshop based on the above mentioned mobile application. In the workshop the author presented a detailed overview of the developed mobile App based on crowd sourcing followed by hands on experience session. Both the sessions were highly interactive. There were multiple choice questions (MCQ) as well as question asking for short suggestions, offering the respondents a free reign. Most of them responded to the questionnaire willingly, and had made some admirable suggestions. The questionnaire for this survey was designed to determine students' self-reported perception and efficacy of mobile technology supported experiential learning for capturing the ground reality. Out of 52, a total of 38 questionnaires were returned representing a response rate of 73%.

5. Results

5.1. Data Analysis

This study administers mixed methodology. From the collected data of questionnaire, the percentage of respondents offering the same answer was computed using MS Excel to produce research findings. The questionnaires were tabulated to record the responses from each participant for each option of the questions. Results were reported both quantitatively and qualitatively. Figures are drawn below to sum up the frequency of responses.

The 1st question was designed to determine the students' perceptions about using mobile App as an experiential learning tool. The student respondents overwhelmingly answered (57+40) % underlining the strong support with reference to their ties and attitude to digital technology integration in the teaching/learning. 12% of the students responded negatively due to their belief that mobile technology adversely affects their learning characteristics

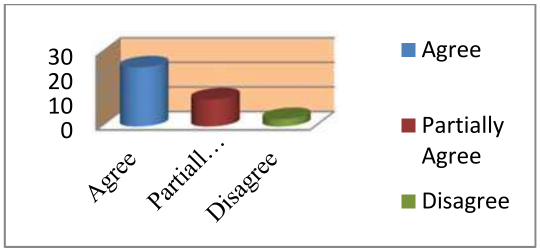

Figure 2: Students' choice of PEERA as an experiential learning tool

The 2nd question seeks to discern the range of efficacy and appropriateness of mobile technology-mediated teaching-learning into environmental education. Here, according to students' opinion (78+20=98%), mobile App-enhanced experiential learning approach creates Inquiry-based learning which engages students in the investigative nature of science. The result of this hypothesis infers students' positive perceptions about technology-enhanced experiential learning in environmental education. It assures that The PEERA educational approach promotes the inquiry based model, using it to transform the scientific findings of formal education to real-life accomplishment.

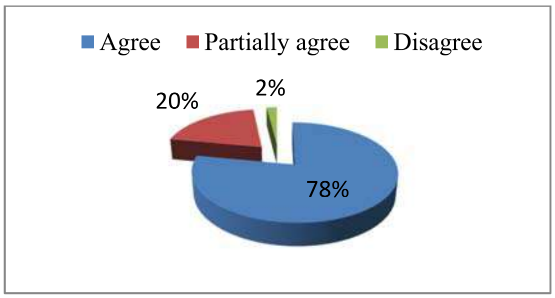

Figure 3: Students' choice about the efficacy of PEERA in Environmental Education

The 3rd question was designed to capture students' reflection regarding teachers' role in a mobile App-mediated mode of pedagogy. Data analysis reflects that PEERA drives the changing trajectory of the teachers' role from a dominator of knowledge to a facilitator. The student participants (64% + 31%= 95%) agreed that technology integration in experiential learning of environmental education facilitates higher degree of teacher-student interaction and collaboration. Consequently, it develops construct an understanding of the world around them, and then experience discrepancies between what they already know and what they discover in their environment. So, App based experiential learning approach enhances learners' autonomy of study and at the same time, reduces teacher-dominated lesson practices. But many of them had anxiety on how a digital migrant can fully explore the potential of a digital native.

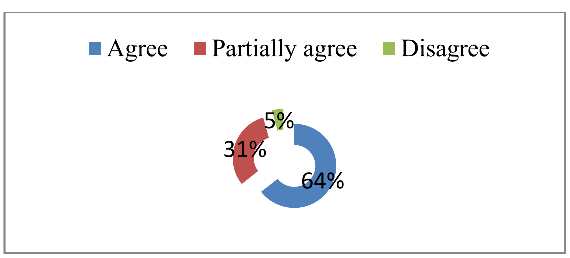

Figure 4: Students' reflection regarding teachers' role as a facilitator

The 4th question explores students' self-reported assertion and perception about crowd sourcing based mobile App as experiential learning tool for environmental education. Most of the participants suggested that App based experiential learning approach contribute in perceptively to the learners' autonomy catering to their real life career. . Here students are engaged and feel empowered as creators of substance. Here students both experience and generate knowledge. They learn from thoughts and ideas about the experience. Each step contributes to their learning. Providing an experience alone does not create experiential learning. Experiences lead to learning if the participant understands what happened, sees patterns of observations, generalizes from those observations and generate new knowledge. Apart from this, some students show their nuances regarding the authenticity of the data collected and very few term it as a troublesome and time consuming technique.

Finally, the 5th question offered the participants a free reign to spell out their own favourable or disfavour able perception or reflections regarding mobile App in learning. The responses reflect the real perceptions of the students representing an average rate of 77%. Most importantly, a contributing number of participants 85% suggested that mobile Application based experiential learning enables students to generate solutions to make decisions or to solve real life problems. Some of them discussed the authenticity of the data collected. A good number of participants showed anxiety regarding the implementation of tool in educational institutions due to lack of smart phones and the versatility of digital immigrant teachers in using the App. Here, the author designed participants' self-reported reflections into structured answers.

6. Discussion and Recommendations

Data analysis of the study tried to sort out convergent and divergent issues concerning students' perceptions and efficacy of Crowdsourcing based Mobile Application as experiential learning tool for environmental education and research. Research analysis highlights that 85% (average, Fig: 4) students show positive attitude confirming the strong support to Crowdsourcing based Mobile Application. Virtually, technology-supported learning portfolio has vitally altered the landscape of education engineering and the way of knowledge transmission from teaching staff to students. Surprisingly, data analytical findings bring to light that Crowdsourcing based Mobile Application enable students both experience and generate knowledge. They learn from thoughts and ideas about the experience. Each step contributes to their learning. Providing an experience alone does not create experiential learning. Experiences lead to learning if the participant understands what happened, sees patterns of observations, generalizes from those observations and generate new knowledge.

7. Conclusion

This article contributes significantly to the effectiveness of PEERA, crowd sourcing based mobile App by investigating students' perception and efficacy of the above said based on data analysis and research findings. The findings reflected that university post graduate students demonstrated positive perception of mobile App technology adoption into their learning practices and it affects their learning situation through captivating and motivating into learning engagement more than traditional pedagogy. Interestingly, 80% of the participants believe it enhances self-directed autonomy of study; facilitating higher degree of teacher-student interaction promoting inquiry and collaborative learning.

In light of the findings of the present paper, we propose that crowd sourcing applications and other associated technologies may be utilized to implement experiential learning in environmental education and it may have the potential to significantly improve attitudinal change in future generation towards environment.

Acknowledgements

This work is supported by Google Earth Engine Faculty Grant. Dr. Divya C.Senan is supported by Raman Postdoctoral Fellowship for Indian Scholars in USA from the University Grants Commission, India.

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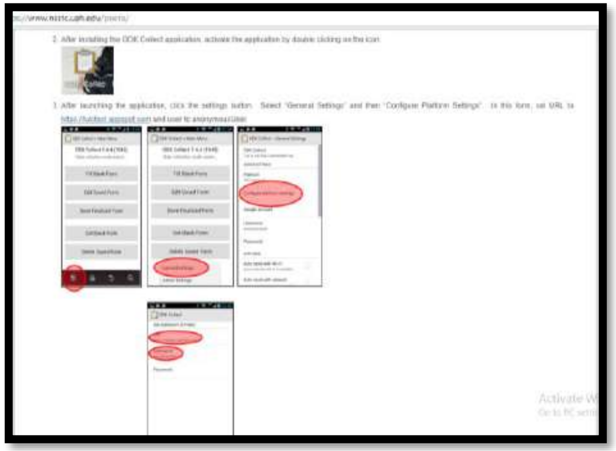

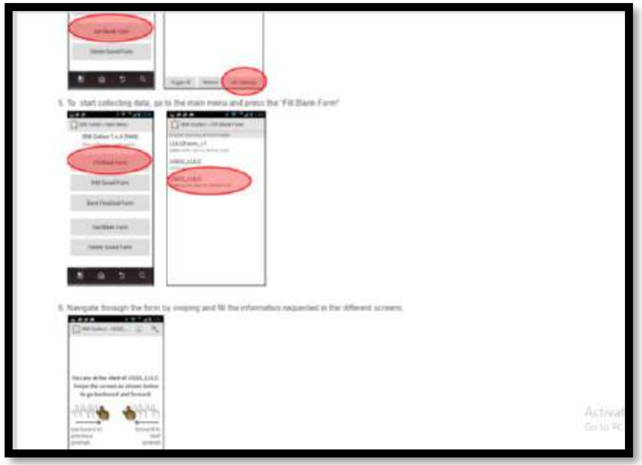

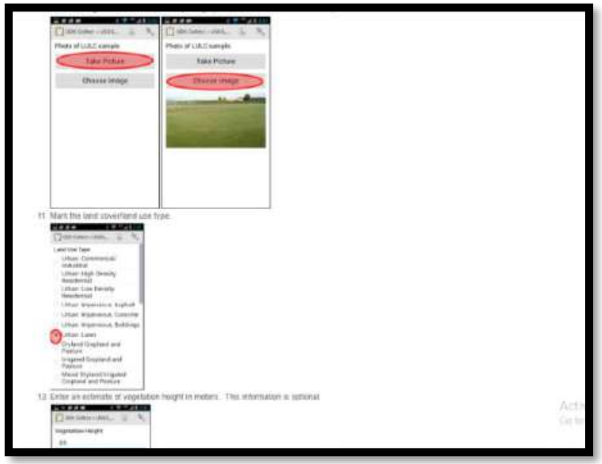

Kerala State Council for Science, Technology and Environment

049/WTU/16/CSTE Dated 17.01.2017

From

The Coordinator
Wetland Technical Unit, KSCSTE

To

Dr Divya C Senan
Asst Professor
Sree Narayana Traning Colege
Nedunganda P O
Trivandrum-695307

Sir,

Sub: Financial Assistance for Wetland Day 2017 programme- reg
Ref: Your application

Please refer your application for financial support for organizing World Wetland Day 2017 programmes. The KSCSTE has examined the proposal and an amount of **Rs.15,000/- (Rupees Fifteen thousand only)** is sanctioned towards the conduct of the programme subject to following conditions.

- The number of participants in the programme should be ensured as per the proposal. All the programmes as per the proposal should be organized.
- The selected agencies shall inform the exact the programmes details to the Coordinator ,WTU, KSCSTE, Sasthra Bhavan, Pattom, Thiruvananthapuram by post or by email to coordinatorwtu@gmail.com before the date of the programme
- KSCSTE should be duly acknowledged in the programme and 'Supported by Kerala State Council for Science, Technology and Environment' should be written in all the brochures, banners (Only cloth banner to be used), other publicity materials etc.
- Each activity should be documented and detailed report should be sent to Council with captioned photographs (Hard copy) highlighting the impact and suggesting follow up activity.
- The financial assistance will be disbursed to the Head of the Institution, only after the successful conduct of the programme, subject to the submission of Activity Report, Statement of expenditure (SE) and, Utilisation certificate in KSCSTE format.The format can be downloaded from the website www.kscste.kerala.gov.in. The aided colleges shall submit audited UC and SE.
- Reports, SE, UC received after one month (latest by 15th March) of conduct of the programme will not be considered for financial assistance.

Yours faithfully

(Dr. P. Harinarayanan)

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