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Validation of E-Learning Software in Introductory Physics

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Abstract: ***The advent of Education 4.0 leads to implicit application of technology especially in higher learning institutions. The use of E-learning platforms becomes prominent, and different studies proved its effectiveness. The study aims to validate an e-learning software in teaching introductory Physics, specifically it seeks to evaluate an e-learning modules in physics, assess and enhance the system as well as appraise the performance of the e- learning software based on the selected criteria of ISO 9126.The study is anchored in the e-learning model which emphasized the analysis, design and evolution of the software and is conducted as a research process. The study is a product and tool research as well as model research which focused on developing instructional system design model for science teachers. Through Purposive sampling 30 IT students, five science instructors and seven IT experts were used as participants respectively. The appraisal of the e-learning software was based on the selected criteria on international organization for standardization / international electro technical commission (ISO/IEC) 9126. The data were collected using weighted mean and Likert scale and interpreted using it. The program was successfully evaluated with a broad average of 4.54, which is translated as excellent based on the given scale and on ISO -9126 software evaluation selected criteria. This shows that the software developed conforms to the standard in question and can be used for instruction.***

Keywords*:* *e-* learning software, instructional system design, e-learning modules

1. Introduction

As we continue to live in technological era, we must adopt our teaching strategies and methodologies in the nature of our learners. Millennial as they are called now are considered as the new 21st century learners. Their span of attention is very short, they want immediate result, they want to access the information quickly and their capability to engage in learning is at new level. Teachers and administrators need to take into consideration the emerging role of technology in the classroom.

The new breed of learners, applications of what they learned or master is very vital to succeed not only in post -secondary institutions but also in the workplace[1]. Moreover the skill development that can be measured and transferred is the primary concerned of learning [2]. in educational technology the most widespread and most expensive equipment now a days is the on-line learning environment[3]. Successful e-learning environment is possible in educational institutions as well as in larger society. Anyone can now easily access documents that was uploaded and can study it by downloading the files.

E-learning as a learning process involving interaction between content delivered online, network-based resources, and support for tutoring.The concept focuses on the innovative effect of technology allowed for networks, we must transform all traditional institutions of learning to prepare students for their future[4].

E-learning was inspired by the evolving development in Information and Technology, communication as well as in the evolution of different pedagogy. As the educational system adopts to the changes brought about by industrial 4.0, innovations and applications of IT are intended for training projects, education and research and development.

Higher education institutions are looking into the enhancement of its ability and standardized capability for the improvement of its performances and delivery of services. They are considering the different technical platforms, organizational models and pedagogical practices to adapt to the ongoing on-line development. The teaching of Physics as a fundamental science requires more illustrations, problem scenarios can be effectively delivered through the use of e-learning software. Likewise integrating technology in teaching Physics increases the performance scores of the students[5].The study aims to validate an e-learning software in teaching introductory Physics, In particular, it aims at evaluating the e-learning modules in physics, evaluating and improving the framework and assessing the performance of the e-learning program on the basis of the selected ISO 9126 criteria.

2. Theoretical Framework of the Study

This study is anchored in the process development model of e-learning which emphasized the software's analysis, design and development.

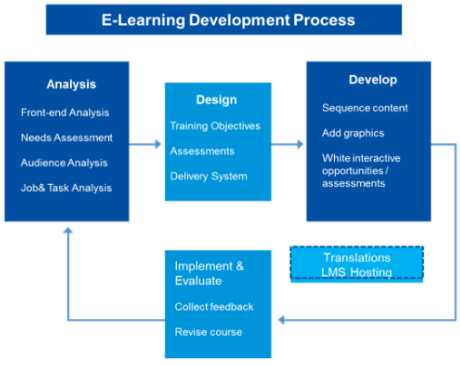

Figure 1: E-learning Development Process Model
Source: Global Learning Solution

Analysis
E-learning creation starts with the analysis of learning contents, objectives and the profile of the prospective respondents. It also considers the different tasks to be performed by the participants and the appropriate instructional strategy that can be utilized so that learning contents that can be presented in the best way possible.

Design
At this stage, learning experts must take into consideration significant requirements from stakeholders, training objectives, assessment needed and design challenge. It must also consider instructional visuals and audio elements in the final design of course curriculum. Integration of the recommendations from the learning management team to create the instructional design needed for the next phase.

Develop
At this phase, inclusion of the important element of instructional design is being finalized, Incorporation of the contents, visuals, and assessment into storyboard are taking place. Interactivities, templates, and execution of specified design documents and use of rapid authorizing tool are in place for giving the final and definite shape of the e- learning course.

It is also anchor in the instructional concept model for the Dick and Carey..System is in essence systematic [6]. This model of instructional design guides the teacher how to build an online model of instructional design following a step-by - step process which includes: Defining instructional goals, performing instructional research, defining entry behavior, writing performance targets, developing assessment methods, developing instructional strategy, developing and selecting instructional materials, planning and implementing formative evaluation and summative evaluation, and revising instruction.

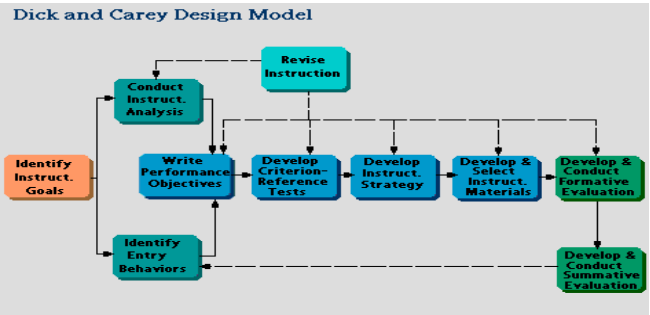

Figure 2: Dick and Carey Design Model

3. Conceptual Framework of the Study

The present analysis is working with the mechanism shown in Fig.2. It consists of three major phases to be used for system development, namely the preliminary phase, prototyping phase and evaluation phase or reflective phase.

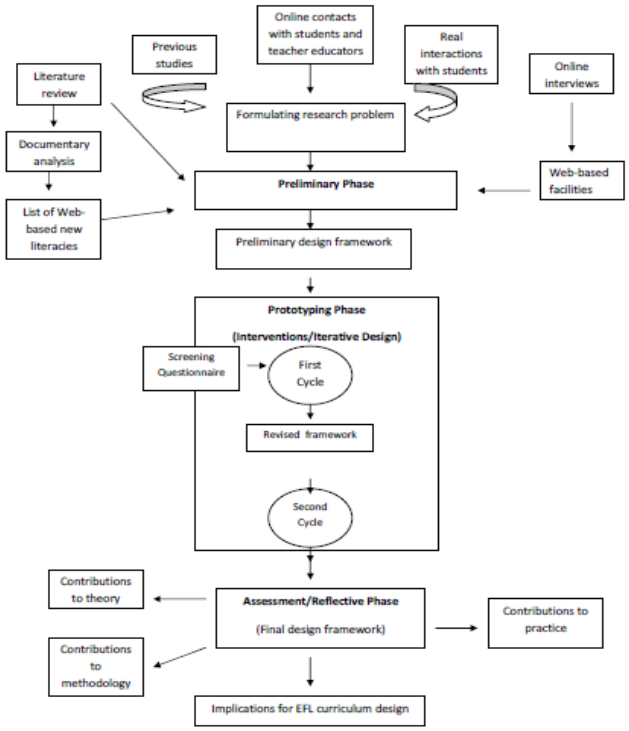

Figure 3: Conceptual Framework of the Study (*Adapted from Abdallah, M. M. S. 2011)[7]*

1) Preliminary research process In this process, review of relevant literatures, study of procedures and contents are carried out, creation of conceptual and theoretical frameworks are also developed, followed by on-line interaction with the respondents, the question is formulated and defined. This phase also involves identifying the gaps which lead to extensive literature review. This serves to provide theoretical basis for the simultaneous documentary analysis. Collecting empirical data also into a list of web-based facilities that will be of great help in the preliminary design process, which will act as a guide to the next stage of the study design.
2) Prototyping phase (iterative design phase), This phase accounts for the two iterations, each of which is a micro-cycle of formative evaluation testing, aimed at enhancing and refining intervention. This process is driven by a conceptual structure of design concluded during the preliminary phase. Screening questionnaire administration was undertaken for purposeful screening, which will result in a revised outcome-based process and guide the next step before a final design process is reached.
3) Appraisal / Reflective Stage. Comprehensive review of the two iterations or testing cycles performed in the preceding stage leads to this step where a final structure for design is reached. This structure also has implications for the design of e-learning curricula, as well as contributions to theory, practice and methodology.

4. Methodology

4.1 Materials and Methods

Design-Based Research
The present study used the design-based research method developed by Collins (1992) and Brown (1992), which focused on the real educational environment in which

participants interact with each other, as well as on design settings rather than laboratory environments.[8] Iterative design and implementation cycles are used within design-based analysis, and each implementation is used as an opportunity to collect data for the subsequent design. It will explain and predict where and how the learning takes place in a real educational setting [9].

To produce information product skills or a complete understanding of any field design -related research is used. The analysis is a review of products and methods as well as model review that centered on the creation of a model of instructional system design for science teachers.

This study should be regarded as a form of model research because it has centered on developing instructional system design model for science teachers. The evaluators' opinions about model based on hypotheses have been collected and evaluated in detail. Those results were then applied repeatedly to revisit the previously developed model.

Research Process

Following the design-driven research model principle, e-learning modules were developed based on the analysis of knowledge and the views of students. The initial stage of the model was developed on the basis of a literature review. Literature analysis served as the basis for improving the new educational framework and creating a user-centric rapid prototype, 'conducting practical and iterative formative assessment,' and 'applying constructivism concepts.' The revision of the e-learning instructional template was based on the respondents' input and evaluation program.

4.2 Sources of Data

The present study used purposive sampling technique to collect the data. It is a form of sampling in which the sample selection is based on the investigators' judgment as to which subject best fits the study's criteria. Table 1 provides a rundown of the total number of study participants.

Table 1: Respondents of the study

Classification	No. of Participants
Students of BSIT & BSCS	30
Science Instructors	5
IT Experts	7
Total	**42**

4.3 Data Gathering Procedure

The data obtained have been taken from the chosen respondents' answered questionnaires. To the respondents was presented the developed software. E-learning software was tested by presenting the program's title and its basic goals. The framework was introduced to the respondents, and demonstrated. Following the demonstration, each respondent examined the method, assessment form was distributed for assessment of the respondent. Their initial findings and feedback were used to develop the e-learning module.

4.4Research Instrument

Selected Criteria from the International Organization for Standardization / International Electro Technical Commission (ISO / IEC) 9126, an international software quality assurance standard was the basis for the construction of the study's primary instrument. The analysis used the assessment method, which is the primary instrument for collecting the data. The assessment form was based on the Semi-structured questionnaire was constructed on other web-related creation to boost system over-all performance.

5. Data Analysis

Respondents were asked to assess the entire device flow and the program according to the following rating scale:

Table 2: Rating Scale

Rating scale	Remarks
4.20 – 5.00	Excellent
3.40 – 4.19	Very Satisfactory
2.60- 3.39	Satisfactory
1.80 – 2.59	Fair
1.0- 1.79	Poor

5.1Statistical Treatment of Data

The collected data were tabulated and interpreted using the weighted mean and the Likert scale shown above.

6. Results and Discussions

6.1 Design of E- learning Modules

Learners varied in the rate of learning as far as mental and intellectual abilities are concerned hence one purpose of modular instruction is to allow student to learn at his own pace[10] Developing an e-learning modules could enhance students' interest in Physics and may lessen difficulty in learning the course. The development of each module in the study was based on the approved learning plan. Each module showed the technology integration which showed the application of the outcome-based approach. Modules consists of the following parts: objectives, pre-test, discussion, activity, post-test and follow-up activity. Technology Integration is applied in Pre-test, discussion of the lesson, and post- test, while outcome-based approach is evident on the performance of the experiment activity and post-activity. In the flow-chart below, the e-learning process of using the e-learning modules is given.

Flowchart of E –Learning Process

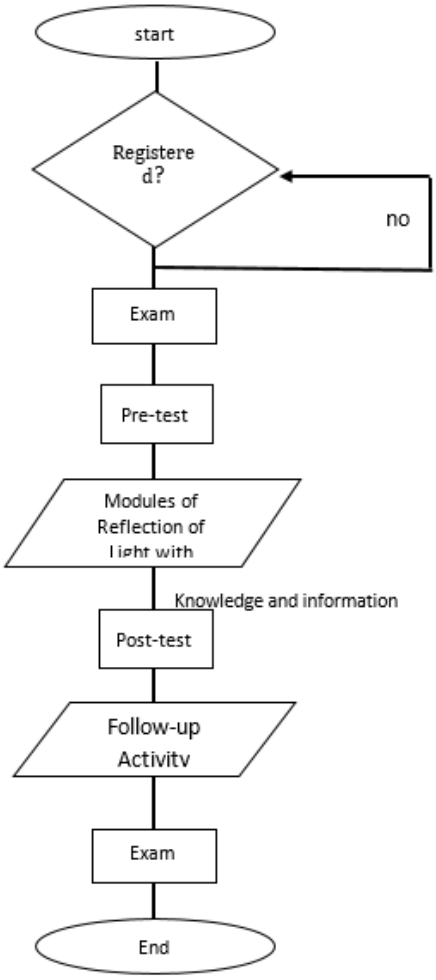

Figure 4: Flow Chart of E- learning Process

Each student is requested to create an account and required to register in the E- learning web module started with a pre- test, the concepts and topics in introductory physics was discussed through you- tube channels where students are given an opportunity to learn it at their own paces, at their own convenient time and place. Practice exercises are provided to develop problem solving skills. Post -test is also given to determine the gain in their conceptual understanding. Follow-up activity through practical application and technology integration is also part of the lesson development. This comprises the components of each modules in the developed e- learning software.

6.2 Evaluation Results

The system was evaluated using standardization / international electro technical commission (ISO / IEC) 9126 selected criteria. That includes evaluation of functionality, reliability, performance, portability, accessibility, technical dimension of knowledge processing, processing, and materials.

The accuracy and appropriation of the system's functions refers to the functionality under this criteria that the system received a 4.6 rating score, which means outstanding, meaning that the system functionality was reliable and performing the functions provided. Measurement process formality, measurement accuracy, and pilot testing are important elements that will help strengthen the online evaluation process,[11].The function of the e-learning software which shows how the software perform without failure describes the reliability of the system. The system gained a rating score of 4.4 which means excellent. It indicates that the system maintained its performance when used by the students, IT experts and Science Instructors.

The capacity of the e-learning software to function in a short period of time with accuracy refers to the efficiency of the system. The system gained a rating score of 4.6 which means excellent. It shows that the system provide appropriate response and used appropriate amount of its resource.

The ability of the e-learning software to change a given software component within a specified environment. Easily refers to portability. Under this criterion, the system gained a rating score of 4.5 which means excellent. This shows that the system can be executed properly on multiple environments.

Usability of the e-learning software is described based on its ability to operate and function with ease in a given environment. The program received a 4.5 ranking which means excellent. It suggests consumers understand the program quickly. Successful development of e-learning emphasized high result of evaluation in its utilization proven in other study [12].

Information software covers the lessons in introductory physics, this includes the manner of presenting the concepts and the completeness of the content covered. The system gained a rating score of 4.5 which means excellent. This shows how the respondents recognized the accuracy and completeness of the topics discussed.

The software and materials technological dimension defines the basic equipment used to produce the program, as well as the device features in graphic presentations. The system gained a rating score of 4.6 which means excellent. This shows that the systems conform to the given standard and effectively used the computer tools for graphic presentations. The summary of the ratings scores is presented in table 3.(Appendix A) This finding is strengthened by other study [13] when it was concluded that the performance of the students tend to increase when exposed to the computer-aided instructional material.

7. Conclusions

The study result showed that the e-learning platform is performing excellently in terms of accessibility, reliability, performance, portability, usability, information processing, platform and materials technical aspects.

The e-learning modules can be used to enhance the success of the students in the acquisition of material awareness. The study result may encourage teachers in higher education institutions to develop teacher-made educational software packages, foster better learning, cater for the needs of millennial leaners, and face the challenges of 4.0. The result of this study is in agreement of the findings of other study

[14] where it highlighted the important association between e-learning and the motivation of the students, so when implementing e-learning, students are more likely to be motivated.

8. Recommendations

The step-by - step process adopted in e-learning software development and validation could serve as a model for teacher training and retraining in developing and validating educational or instructional software packages.

Website design enhancement can be considered to include more interactive websites and sensitive website to make it more attractive and relevant to the learners ' needs.

This work may be replicated by other researchers by preparing instructional modules for other topics in introductory physics and in other disciplines and conducting an experimental design is also recommended to validate further the findings of the study.

9. Acknowledgement

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References

[1] Blair, F (2012). TECHNOLOGY INTEGRATION FOR THE NEW 21ST CENTURY, (February), 8–13

[2] Dewey (1966). Democracy and Education: An Introduction to the Philosophy of Education. New York: Free Press.

[3] Davies R. S. West, R.E. (2014). Technology integration in schools. In *Handbook of research on - educational communication and technology* (4th ed., pp.841-853). Springer New York

[4] Markus, B. (2008). Thinking about e-learning. Proceedings FIG International Workshop. Sharing Good Practices: E-learning in Surveying, Geo-information Sciences and Land Administration, 11–13 June 2008, ITC, Enschede, the Netherlands.

[5] Navarro, L. C. (2017). Technology Integration Using Outcome Based Education Approach In Teaching Introductory, *3*(2), 1102–1116.

[6] Dick, W. & Carey, L.M. (1978, 1985, 1990, 1996).*The systematic design of instruction*. (editions 1 through 4.) New York: HarperCollins.

[7] Abdallah, M. M. S. (2011). *Web-based new literacies and EFL curriculum design in teacher education: A design study for expanding EFL student teachers' language-related literacy practices in an Egyptian pre-service teacher education programme*. PhDThesis. Graduate School of Education, College of Social Sciences and InternationalStudies, University of Exeter, UK.

[8] Collins, A. (1992). Toward a design science of education. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology*. Berlin, Germany: Springer-Verlag.

[9] Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences, 2*(2), 141–178.

[10] Martinez, D.T., T.U. GanironJr and H. S. Taylor (2014), Curriculum Development of Hardware Interfacing System for Visual C++ in Computer Engineering Course, *Journal of Proceedings of the 42nd Annual Conference of the European Society for Engineering Education (SEFI)*, Birmingham, United Kingdom

[11] Conceição, S. C. O., Strachota, E., & Schmidt, S. W. (2007). The Development and Validation of an Instrument to Evaluate Online Training Materials, (2001).

[12] Gustiani, I., Widodo, A., &Suwarma, I. R. (2017). Development and validation of science , technology , engineering and mathematics (STEM) based instructional material Development and Validation of Science , Technology , Engineering and Mathematics (STEM) based Instructional Material, *060001*(May). https://doi.org/10.1063/1.4983969

[13] Abarro, V. F. (2016). Development and Validation of a Computer Aided Instructional Material in Selected Topics in Elementary Algebra, *6*(6), 78–80.

[14] Safi yehRajaeeHarandi /Procedia - Social and Behavioral Sciences 181 (2015) 423 – 430

Appendix A

Table 3: Evaluation Results

Evaluation Criteria	Rating Scale					Mean	Interpretation
	5	4	3	2	1		
Functionality							
1. The software provides functions	30	7	5	0	0	4.6	Excellent
2. The software shows accurate information and results	28	9	5	0	0	4.5	Excellent
3. The software provides security measures	29	7	5	1	0	4.5	Excellent
Reliability							
1. The software shows no failure or bugs	29	8	5	0	0	4.3	Excellent
2. The integrity of data is maintained all throughout its operation	28	9	4	1	0	4.5	Excellent

Efficiency							
1. the software operates quickly and efficiently	30	8	4	0	0	4.6	Excellent
2. The software requires less resources	29	9	4	0	0	4.6	Excellent
Portability							
1. The software adapts to new specifications or operating environments	29	9	4	0	0	4.6	Excellent
2. The software requires less efforts to install	27	11	4	0	0	4.5	Excellent
Usability							
1. The software functions are organized, clear, logical	30	7	5	0	0	4.6	Excellent
2. The user can operate the software with ease	27	11	4	0	0	4.5	Excellent
3. the user's guide is available and clear	26	9	6	0	0	4.4	Excellent
Information Software							
1. The information is clear, concise and informative to the intended user	30	8	4	0	0	4.6	Excellent
2. The content is free from spelling and grammatical errors	27	11	4	0	0	4.5	Excellent
3. The content are covered in a complete manner.	30	8	4	0	0	4.6	Excellent
Technical aspect of the software and materials							
1. The software uses standard equipment that is reliable, widely available, and applicable to a variety of uses.	32	6	4		0	4.7	Excellent
2. Computer capabilities such as graphics, colors are used for appropriate instructional reasons.	29	9	4	0	0	4.6	Excellent
Grand Mean						**4.54**	**Excellent**