PRODUCT EVALUATION OF THE NEWLY DEVELOPED WEB-BASED GENERAL EDUCATION MATHEMATICS REVIEWER FOR TEACHER LICENSURE

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ABSTRACT. *The study aims to evaluate the newly developed web-based general education mathematics reviewer for teacher licensure. The reviewer was evaluated by one hundred thirty (130) participants of the study and the following participants are graduating from teacher education. This study utilizes the Design and Developmental Research DDR because it is a scientific research method that seeks to create knowledge based on data that are systematically derived from practice* [1]*. Mean and Standard Deviation were used to evaluate the Product Quality (ISO/IEC 25010) level of the web-based general education mathematics reviewer regarding Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. The result revealed that the web-based reviewer's quality satisfied the evaluation concerning the ISO standard. The mathematics teachers may use the web-based reviewer as their instructional material to give their students reviews and drill exercises.*

Keywords: Web-Based Application, LET Reviewer, General Mathematics, Product Quality (ISO/IEC 25010), ADDIE Model

1. INTRODUCTION

Licensure Examination for Teachers (LET) is one of the challenging parts of being a teacher education graduate because this examination measures the extent of the knowledge acquired by teacher education graduates. In addition, the education graduate comprehensively studies, review, and remember again all-inclusive subjects and topics that have already been taken up. In March 2014, PBED (Philippine Business for Education) stated that most teacher education institutions perform poorly in the licensure exams. A recent study showed that most teacher education institutions had not reached the national test-taker passing rates. Moreover, mathematics subject makes that passing rates low, and most of the students have difficulty in learning. According to Z. Kariuki et al. [2], students' mathematics performance has been persistently poor.

To address the low performance and difficulty in learning mathematics, teacher education graduates undergo review classes conducted by the schools and review centers. Some studies revealed that attendance in LET review classes significantly influenced performance in the LET [3,4]. Consequently, Kalaw [5] proposed more intensified LET reviews for education graduates should be conducted. Also, Salundaguit [6] and Herrero [7] recommended reviewing the policies for teacher education programs, particularly on the entry and retention policies, faculty commitment, and the conduct of review classes and mock board exams.

In the case of teacher education graduates, after graduation, some prepare themselves by taking the board examination and enrolling in review classes. Unfortunately, some of the graduates take a break from school-related activities and have some rest and vacation activities which might result negatively in difficulty in remembering, if not forgetting, the previous lessons and learnings one has acquired in the past years of studying.

Attending the review classes needs lots of time and money. One of the costly items in review centers is the review materials which are provided for a fee. The schedule of review classes also demands a huge part of the reviewees' time, especially in mathematics subjects where many topics are to be studied with sufficient time.

In connection with these challenges, the researcher aims to develop compact features of web-based general education mathematics reviewers, which can be viewed and used on phones, tablets, and computers. Traditional learning methods have significantly changed with the adaptation of modern technologies. Teachers and students have become more interested in building their knowledge when exploring learning materials using various devices and applications [8]. Mobile and online learning applications have become more known year after year. They are used today by millions of students and educators worldwide. Wireless mobile devices like smartphones, PDAs, and tablets could benefit students' learning in or out of the classroom. In front of the idea of inclusion of mobile learning in the educational process, some important case studies examine the consequence of using mobile tools and apps, as well as online applications in mathematics teaching, at all educational levels [9]. The relatively recent application of these technologies in education they have enormous potential: they improve student motivation and learning, can be adapted to different learning styles, reduce social inequalities, and facilitate inclusiveness and diversity practices in the classroom [10].

The five phases of the Inquiry-Based Instructional Model are manifested in the web-based general education mathematics reviewer: (1) Engage – the "Assessment" feature of the web-based general education mathematics reviewer gauges the user's prior knowledge and/or identifies possible misconceptions. (2) Explore – the "Review Time," "Study More," "Formulas," "Dictionary," and "Math Resources" provides users with baseline hands-on activities where users practice prior knowledge to inquire, generate new ideas, and conduct an initial investigation. (3) Explain – the "Review Time" feature includes a detailed explanation of the solution for each question where formal definitions, notes, and labels are provided. (4) Elaborate – the "Study More," "Formulas," "Dictionary," and "Math Resources" are features of the online reviewer to apply their new understanding of concepts while reinforcing new skills, sharing information and ideas, or applying the knowledge and skills to other disciplines. (5) Evaluate – the "Assessment" feature of the web-based general education mathematics reviewer encourages users to

assess their understanding and abilities. It provides opportunities for teachers to evaluate users' progress toward achieving the educational objectives.

According to Wiseman [11], the new way of learning, the e-learning mode with the traditional orientation of education and derivation of the new trend, is based on the learning approaches. This makes the new trend flexible and applicable to mathematics.

The main objective of this study is to evaluate the Product Quality level of the web-based general education mathematics reviewer in terms of Performance Efficiency, Functional Suitability, Compatibility, Usability, Reliability, Security, Maintainability, and Portability.

ADDIE Model

The web-based general education mathematics reviewer development for teacher licensure is mainly anchored on the ADDIE model. ADDIE is a standard procedure and method used by instructional designers and training creators. The model's phases include analysis, design, development, implementation, and evaluation. Each phase represents a dynamic and flexible standard for developing efficient training and performance support instruments [12]. Currently, ADDIE is considered the most commonly implemented model for instructional materials. The five phases interconnect and interrelate, and the model can be adapted to all environments.

Product Quality

Computer application is increasingly used for various purposes and to ensure the adequate quality of product/s. The International Organization for Standardization (ISO) developed complete specifications and evaluations of software product quality. The organization defines the appropriate quality characteristics for the evaluation of the software product. The study of Ngadiman [8], Babar [13], Hussain and Mkpojiogu [14], and Esaki [15] used the ISO/IEC 25010 product quality requirements in analyzing the software product. This study is much related to the current study since the product quality of the developed instructional material will be evaluated using ISO standards.

2. MATERIAL AND METHODS

Further, this study adopts the Design and Developmental Research (DDR) procedures. DDR is a useful research approach for practitioners interested in the domains of instructional technology and curriculum development because DDR procedures provide empirical data that assist in developing new theories and knowledge that contribute to a more informed practice in designing instruction [16].

This study utilizes the DDR because it is a scientific research method that seeks to create knowledge based on data that are systematically derived from practice [17]. This study employs the DDR to develop a Web-Based and Inquiry-based learning General Education Mathematics Reviewer because the procedure goes through the process of systematic analysis in several phases, such as analysis, design, development, implementation, and evaluation, based on a specific case that produces context-specific knowledge that serves a problem-solving function [17].

The study has one hundred thirty (130) participants; the following participants are the graduating teacher education students from Caraga State University Cabadbaran City, Caraga Region, and University of Science and Technology of Southern Philippines CDO Campus, Region 10. The two universities are SUC level IV universities in the Philippines.

The instrument is adopted by International Organization for Standardization (ISO). The Product Quality - ISO/IEC 25010 instrument was used to evaluate the quality of the application used in the study. The users' answered the items according to their experience and observation while using the application.

Furthermore, the researcher used mean and standard deviation to determine the Product Quality level of the web-based general education mathematics reviewer.

3. RESULTS AND DISCUSSION

Table 1 presents the product quality level of web-based general education mathematics reviewer. It reveals that the web-based general education mathematics reviewer as an application has a Very High Quality as showed in the mean of 3.64 and standard deviation of 0.38. This means that web-based general education mathematics reviewer passed the standard quality of IT applications regarding Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability.

Specifically, Table 1 also presents the main characteristics and sub-characteristics of Product Quality; it shows that the web-based general education mathematics reviewer has a Very High Quality in terms of Functional Suitability with a mean of 3.73 and a standard deviation of 0.42. Moreover, functional completeness, in which the set of operations covers all the specified tasks and user objectives (3.75); functional correctness which a system provides the correct outputs with the needed degree of precision (3.72); and functional appropriateness, which the functions facilitate the accomplishment of assigned tasks and objectives (3.72) has a very high quality.

It reveals that the web-based general education mathematics reviewer as an application has a Very High Quality in terms of performance efficiency, with a mean of 3.63 and a standard deviation of 0.45. Also reveals the sub-characteristics of performance efficiency; it shows that the web-based general education mathematics reviewer has a Very High Quality in terms of time behavior which the response and processing times and output rates of a system when performing its functions meet requirements (3.59), resource utilization which the values and types of resources used by a product or system, when processing its functions, meet requirements (3.65), and capacity which the supreme limits of a product or system parameter meet requirements (3.63).

Table 1. Product Quality (ISO/IEC 25010) Level of Web-Based General Education Mathematics Reviewer

Characteristic	SD	Mean	VI
Functional Suitability			
Functional completeness	0.45	3.75	VHQ
Functional correctness	0.47	3.72	VHQ
Functional appropriateness	0.47	3.72	VHQ
Grand Mean	**0.42**	**3.73**	VHQ
Performance Efficiency			
Time behavior	0.51	3.59	VHQ

Resource utilization	0.49	3.65	VHQ
Capacity	0.50	3.63	VHQ
Grand Mean	**0.45**	**3.63**	VHQ
Compatibility			
Co-existence.	0.51	3.61	VHQ
Interoperability.	0.53	3.58	VHQ
Grand Mean	**0.49**	**3.59**	VHQ
Usability			
Appropriateness recognizability.	0.49	3.67	VHQ
Learnability.	0.50	3.62	VHQ
Operability.	0.50	3.65	VHQ
User error protection.	0.53	3.56	VHQ
User interface aesthetics.	0.52	3.59	VHQ
Accessibility.	0.50	3.63	VHQ
Grand Mean	**0.43**	**3.62**	VHQ
Reliability			
Maturity.	0.50	3.64	VHQ
Availability.	0.53	3.62	VHQ
Fault tolerance.	0.51	3.58	VHQ
Recoverability.	0.49	3.62	VHQ
Grand Mean	**0.43**	**3.62**	VHQ
Security			
Confidentiality.	0.47	3.67	VHQ
Integrity.	0.48	3.69	VHQ
Non-repudiation.	0.52	3.63	VHQ
Accountability.	0.49	3.68	VHQ
Authenticity.	0.51	3.65	VHQ
Grand Mean	**0.41**	**3.66**	VHQ
Maintainability			
Modularity.	0.50	3.62	VHQ
Reusability.	0.47	3.68	VHQ
Analyzability.	0.48	3.65	VHQ
Modifiability.	0.51	3.59	VHQ
Testability.	0.50	3.63	VHQ
Grand Mean	**0.42**	**3.63**	VHQ
Portability			
Adaptability.	0.47	3.67	VHQ
Installability.	0.50	3.62	VHQ
Replaceability.	0.51	3.60	VHQ
Grand Mean	**0.44**	**3.63**	VHQ
Overall Grand Mean	**0.38**	**3.64**	VHQ

Legend: Very Low Quality (VLQ) (1.00-1.50); Low Quality (LQ) (1.51-2.50); High Quality (HQ) (2.51-3.50); Very High Quality (VHQ) (3.51-4.00).

It shows that the web-based reviewer as an application has a Very High Quality in terms of compatibility, with a mean of 3.59 and a standard deviation of 0.49. Additionally, the sub-characteristics of compatibility show that the web-based reviewer has a Very High Quality in terms of co-existence which a product can process its required functions efficiently while sharing a common location and resources with other products without damaging impact on any other product (3.61) and interoperability which two or more systems, products or components can exchange data and use the data that has been exchanged (3.58).

The web-based reviewer as an application has a Very High Quality in terms of usability, with a mean of 3.62 and a standard deviation of 0.43. Moreover, the sub-characteristics of usability, it shows that the web-based reviewer has a Very High Quality in terms of appropriateness recognizability which users can identify whether a product or system is appropriate for their needs (3.67), learnability which a system can be used by specified users to accomplished specified goals of learning to use the system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use (3.62), operability which a system has attributes that make it easy to operate and control (3.65), user error protection which a system protects users against making errors (3.56), user interface aesthetics which a user interface enables pleasing and satisfying interaction for the user (3.59), and accessibility which a system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use (3.63).

It tells that the web-based reviewer as an application has a Very High Quality in terms of reliability, with a mean of 3.62 and a standard deviation of 0.43. Also, the sub-characteristics of reliability show that the web-based reviewer has a Very High Quality in terms of maturity, which a system, product, or component meets needs for reliability under normal process (3.64), availability which a system, product, or feature is operational and accessible when required for use (3.62), fault tolerance which a system, product or component operates as intended despite the presence of hardware or software faults (3.58), and recoverability which in the event of an interruption or a failure, a system can recover the data directly affected and re-establish the desired state of the system (3.62).

The web-based reviewer as an application has a Very High Quality in terms of security, with a mean of 3.66 and a standard deviation of 0.41. Table 1 reveals the sub-characteristics of security; it shows that the web-based reviewer has a Very High Quality in terms of confidentiality, which a system ensures that data are accessible only to those authorized to have access (3.67), integrity which a system, component prevents unauthorized access to or changes of, computer programs or data (3.69), non-repudiation which actions can be proven to have taken place so that the actions cannot be repudiated later (3.63), accountability which the movements of an entity can be traced distinctively to the entity (3.68), and authenticity which the identity of a resource can be proved to be the one claimed (3.65).

It reveals that the web-based reviewer as an application has a Very High Quality in terms of maintainability, with a mean of 3.63 and a standard deviation of 0.42. Also, the sub-characteristics of maintainability, it shows that the web-based reviewer has a Very High Quality in terms of modularity which a system or computer application is build of discrete components such that a change to one component has less impact on other components (3.62), reusability which an asset can be used in more than one system, or in developing other assets (3.68), analyzability of effectiveness and efficiency which it is possible to assess the impact on a system of an intended change to one or more of its parts, or to test a system for deficiencies or reasons of failures, or to identify parts to be changed (3.65), modifiability which a system can be effectively and efficiently modified without presenting defects or degrading existing product quality (3.59), and testability of effectiveness and efficiency which assessment standards can be established for a system, product, and assessments can be performed to determine whether those standards have been achieved (3.63).

Lastly, the web-based reviewer as an application has a Very High Quality in terms of portability, with a mean of 3.63 and a standard deviation of 0.44. Additionally, the sub-characteristics of portability show that the web-based reviewer has a Very High Quality in terms of adaptability, which a product or system can effectively and efficiently be altered for different or evolving hardware, software, or other processes or usage platforms (3.67), installability effectiveness and efficiency which a system can be successfully installed and/or uninstalled in a specified platform (3.62), and replaceability which a product can replace another selected application product for the same purpose in the same platform (3.60).

4. CONCLUSION AND RECOMMENDATION

Based on the data gathered, the following conclusions and recommendations are given:

1. The web-based reviewer's quality satisfied the evaluation concerning the ISO standard.
2. The mathematics teachers may use the web-based reviewer as their instructional material to give their students reviews and drill exercises. The teachers may develop an upgraded version of the application related to a web-based reviewer for education mathematics.

The web-based reviewer can be accessed to this link: https://sites.google.com/csucc.edu.ph/math-reviewer/gem-reviewer

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