

Inquiry-Based Online General Education Mathematics (GEM) Reviewer Promoting Mock Licensure Examination for Teachers Performance

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Abstract The study aimed to determine the effects of the inquiry-based “Online General Education Mathematics GEM Reviewer” on the mathematics performance of the 130 graduating teacher education students who are enrolled in the Licensure Examination for Teachers (LET) Review subjects in 1st Semester of School Year 2021 – 2022 at Caraga State University Cabadbaran City and University of Science and Technology of Southern Philippines, Cagayan de Oro City. The study used the One-Group Pretest-posttest Design to determine the performance of the Graduating Teacher Education Students in the area of General Education Mathematics. This is an experiment where one group undergoes a pre-experimental (Pretest) evaluation followed by an investigation of the effects of the “Online GEM Reviewer” on the mathematics performance of the users and subsequently, a post-experimental evaluation (Posttest). The researcher employed a Mathematics Performance Test to determine the level of the knowledge of the students. Mean, standard deviation and percentage were used to establish the level of mathematics performance of the Graduating Teacher Education Students and t-test was used to determine the effects of the usage of the “Online GEM Reviewer”. The results revealed that the use of Inquiry-Based “Online GEM Reviewer” influence the mathematics performance of the Graduating Teacher Education Students.

Keywords: computer-assisted learning, inquiry-based learning, online application, mathematics performance, LET reviewer, LET

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1. Introduction

The state recognizes the vital role of teachers in nation-building and development through a responsible and literate citizenry. Towards this end, the state shall ensure and promote quality education by proper supervision and regulation of the licensure examination and professionalization of the practice of the teaching profession (RA 7836, Sec. 2) [1]. A valid certificate of registration and a valid professional license from the Professional Regulations Commission (PRC) are required before any person can practice as a professional teacher in the Philippines, except as otherwise allowed under this Act (RA 7836, Sec. 13) [1]. Hence, taking the Licensure Examination for Teacher (LET) is one of the challenging parts of being a teacher education graduate because this examination measures the extent of knowledge acquired by teacher education graduates. In addition, an education graduate will comprehensively study, review, and recall all-inclusive subjects and topics to pass the licensure

examination. An article published by Rappler Philippines in March 2014 states that most schools for teachers perform poorly in the licensure exam according to Philippine Business for Education (PBED). Their recent study showed that most teacher education institutions did not reach the national test-taker passing rate. Moreover, Mathematics is one of the subjects that students perform poorly because they find it hard to learn, which results to low examination results. According to Kariuki, Kibet, Mungiria, George, & Nkonke [2], student performance in Mathematics has persistently been poor.

To address the low performance and difficulty in learning mathematics, teacher education graduate must undergo review classes conducted by the schools and review centers. Several studies revealed that attendance in LET review classes significantly influence the performance in the LET [3,4]. Consequently, Kalaw [5] proposed that education students must take intensified LET review. Salundaguit [6] and Herrero [7] also recommended to review the policies for teacher education programs particularly on the entry and retention policies, faculty commitment, and the conduct of review classes and mock board exam.

In the case of our teacher education graduates, majority of them prepare to take the board examination and enroll in review classes. On the other hand, a small portion of the graduates take a break from school related activities and postpone their preparation for the board examination which might have an effect in their examination performance later. The interval or delay in the examination preparation activities may have an influence in the decay of relevant learned concepts. According to the Decay Theory, we forget things or events because memory fades with time. This theory suggests that there is a greater chance of forgetting things and events as time passes by. Thus, memories are not permanent [8]. In the same way, you forget the facts, and concepts that you learn when you do not review and remember them.

Attending review classes requires time and money. Review materials are not free and costly. The schedule of review classes also demands a huge part of the time of the reviewee. Mathematics requires sufficient time for comprehension and practice.

To address the concerns on LET review and performance, this study explored the role of the developed online reviewer where the researcher examined and assessed its effects on the mathematics performance of the graduating teacher education students. According to Wiseman [9], the new way of learning is the e-learning mode with the traditional orientation of education and derivation of the new trend, which is based on the learning approaches that makes the new trend flexible and applicable for all mathematical courses.

The features of the “Online General Education Mathematics GEM Reviewer” are anchored on the 5E Inquiry-Based Instructional Model. The 5E learning cycle guide students in five phases: Engage, Explore, Explain, Elaborate, and Evaluate. The 5E Instructional Model brings consistency to different teaching strategies and delivers links among educational activities [10]. Compared to traditional teaching models, the 5E learning cycle results in greater benefits concerning students’ ability for scientific inquiry [11].

Moreover, the five phases of Inquiry-Based Instructional Model are manifested in “Online General Education Mathematics GEM Reviewer”: (1) Engage – the “Assessment” feature of GEM 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 a baseline hands-on activities where users practice prior knowledge to inquire, generate new ideas, and conduct 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, share information and ideas, or apply their knowledge and skills to other disciplines. (5) Evaluate – the “Assessment” feature of the GEM Reviewer encourages users to assess their understanding and abilities and provides opportunities for teachers to evaluate users progress toward achieving the educational objectives.

This study aimed to determine the effects of inquiry-based learning through the online reviewer system for General Education Mathematics (GEM) called the “Online GEM Reviewer.” Specifically, it sought answers the following questions:

1. What are the pre and post assessment mean scores of the “Online GEM Reviewer” users in terms of their performance in mathematics?
2. Is there a significant difference between the pre assessment and post assessment mean scores of the “Online GEM Reviewer” users?

1.1. Computer-Assisted Learning (CAL)

Mathematics is an abstract subject and symbol occupies a critical position. Students find it difficult to comprehend this subject. There are many failures in mathematics than any other subject. Considering student teacher ratio and heterogeneous group of students in a normal classroom it is exceedingly difficult for a teacher to provide individual guidance to all the students. Hence, there is a need for supplemental teaching to the standard classroom teaching. CAL plays a significant role in this situation [12].

CAL is an educational environment that uses a computer program, or an application as they are commonly known, to assist the user in learning a particular subject. Technology assisted learning refers to an overall integrative approach of instructional methods and is part of the bigger picture. With the change in basic assumptions in technology, with internet, smart phone, iPad, and book reader devices, CAL has evolved from just computer aided learning to Technology aided learning. This technology aided learning could be a form of software application and hardware device utilized as aid to an overall learning strategy – which is a conglomeration of other methods of instruction, (e.g., the lecture, tutorial sheets, textbooks etc.) [13].

Computer technology in education started in the 1960s. It claimed that computers can support instructional methods and thus improve student performance [14]. The users used CAL to assist them in the learning process for a particular topic and help increase the learning of the user [13]. CAL refers to the learning method that uses computer as an instrument to aid and improve teaching. It also uses various presentation such as tutorials, drill and practice, simulation, and problem-solving approaches to introduce the topics, and evaluate the user’s performance.

Current research proposed and pointed out that CAL helped increase the mathematics performance of the students [12,15,16]. Computer-based learning as a new medium aided by technology will help increase the learning of the students [17].

Furió, Juan, Seguí, & Vivó [18], Al-Jewair, Qutub, Malkhassian, & Dempster [19] and Looi et al. [20] compared the two methods of teaching, using an iPhone game (CAL) and the traditional classroom lesson. They measured the two methods in terms of effectiveness and satisfaction of the students. The results showed that iPhone game is more satisfying and has higher motivational factor compared to a traditional classroom lesson.

These above reviewed literatures and research works supported the use of technology-based instructional material for which this present study explored.

1.2. Inquiry-Based Learning (IBL)

Teachers commonly ask, “How can I motivate my students' interest and get them excited about the subject they are studying?”. One way to do this is to give students inquiry-based activities that are relevant to their lives and future careers and give them the opportunity to engage in course concepts and tasks [21]. There are five important theme/issues for inquiry-based learning in mathematics: 1) communication in the mathematics environment, 2) mathematical competence, 3) moving in and out of the mathematical domain, 4) tools and resources for planning and implementing inquiry-based learning, and 5) professional development and collaboration [22]. Inquiry-based learning is gaining popularity in teaching. One of the underlying reasons is flexibility for improvement due to the recent technical developments that allows the integration of electronic learning environments with inquiry process [23]. Research has consistently shown that inquiry-based learning can be more effective than other, more expository instructional approaches if students given the adequate support [24]. The students who experiencing inquiry-based learning achieved higher scores [25,26].

IBL shows positive outcomes on academic and achievement of the students [27,28,29,30]. In addition, a positive outcome to the skills leads to a deeper learning of the students. This study relates to the present study because the researcher used the inquiry-based learning method to measure the mathematics performance of the users. The inquiry-based computer simulation proved to be effective in enhancing the skills and learning of the students [31,32]. It is recommended in many policy and curriculum documents because IBL is a student-centered method in teaching mathematics, has very clear surface, deep, and implicit configurations as well as it engages students to think and act like experts [23,33,34].

2. Methods

The study used the One-Group Pretest-posttest Design to determine the mathematics performance of the graduating teacher education students in general education mathematics. This is an experiment where one group undergoes a pre-experimental (Pretest) evaluation followed by an investigation of the effects of the “Online GEM Reviewer” on the mathematics performance of the users through a post-experimental evaluation (Posttest).

The study was conducted at Caraga State University Cabadbaran City and at the University of Science and Technology of Southern Philippines, Cagayan de Oro City. A total of 130 graduating teacher education students enrolled in the review subject in the 1st Semester of School Year 2021 – 2022 participated the study.

To evaluate the pre- and post-performance, the graduating teacher education students took the Mathematics Performance Test. As to the content, the researcher compiled questions from different mathematics books and review materials.

The 50-item researcher-made instrument undergo a pilot test and yielded a coefficient of reliability of Cronbach Alpha = 0.718 which implies a higher level of reliability.

The researcher administered a pretest on mathematics performance test to determine the level of the prior knowledge of the students. The students, unaware that they were participants of the study, were pre-evaluated during the second week of September 2021. After the conduct of the test, the researcher sent the link of the review application “Online GEM Reviewer,” to the participants which they started to use as their reviewer for nine (9) weeks. Subsequently, the participants took the posttest on mathematical performance.

Furthermore, the researcher used the mean and standard deviation to determine the level of mathematics performance of the graduating teacher education students in general education mathematics, and t-test to determine the effects of the usage of the “Online GEM Reviewer.”

3. Results and Discussion

Table 1 illustrates the results and analysis of mean scores of the participants’ mathematics performance. It shows that the overall mean performance of the participants in mathematics is 29.49. This means that the participants level of performance prior to the use of the online reviewer, is at beginning level. The table also shows the mean score of specific subject areas, Fundamental of Mathematics (6.18), Elementary Algebra (5.85), Plane Geometry (6.56), Probability (4.74) and Statistics (6.16), which implies that the participants level of performance is also at beginning level. There are many factors contributing to poor mathematics performance of the students such as mathematics anxiety [35,36,37,38] and mathematics self- efficacy [39,40]. On the other hand, the posttest result in Table 2 shows a significant improvement of their mathematics performance. It shows that the over-all mean score performance of the participants in mathematics is 41.40 which implies that the level of performance of the participants is at Approaching Proficiency level.

Table 1. Level of Participants Pre-Test Mathematics Performance

Subjects Areas	Pre-Test		Descriptive Level
	SD	Mean	
Fundamental of Mathematics	3.37	6.18	Beginning
Elementary Algebra	2.79	5.85	Beginning
Plane Geometry	2.59	6.56	Beginning
Probability	2.10	4.74	Beginning
Statistics	2.04	6.16	Beginning
Over - all Performance	11.12	29.49	Beginning

Subject Area Perfect Mean is 10

Over -all Performance Perfect Mean is 50

Legend:

Mean Intervals Description

(9.00 & above); (45.00 & above) Advanced

(8.50 - 8.99); (42.50 - 44.99) Proficient

(8.00 - 8.49); (40.00 - 42.49) Approaching Proficiency

(7.50 - 7.99); (37.50 - 39.99) Developing

(7.49 & below); (37.49 & below) Beginning

Table 2. Level of Participants Post-Test Mathematics Performance

Subjects Areas	Post Test		Descriptive Level
	SD	Mean	
Fundamental of Mathematics	2.10	8.87	Proficient
Elementary Algebra	2.15	8.58	Proficient
Plane Geometry	1.84	8.58	Proficient
Probability	2.09	7.54	Developing
Statistics	2.13	7.97	Approaching Proficiency
Over - all Performance	8.98	41.40	Approaching Proficiency

Subject Area Perfect Mean is 10

Over -all Performance Perfect Mean is 50.

Table 3 presents the significant difference in pre-assessment and post assessment mean scores of the participants in terms of their performance in mathematics. It revealed that there is a significant difference in pre-assessment and post assessment mean scores of the participants in terms of performance in mathematics as indicated by its p-value of 0.01 which is less than 0.05 that yields to reject the null hypothesis. Also in Table 3, it revealed that there is a significant difference in pre-assessment and post assessment mean scores of the "Online GEM Reviewer" participants in specific general education mathematics areas, particularly in fundamental of mathematics, elementary algebra, plane geometry, probability, and statistics. All computed p-value were at 0.01 which are less than 0.05 that yields to reject the null hypothesis. Additionally, Table 3 shows the effect size (Cohen's d) of the pre and post assessment mean scores of the participants. It revealed that there is a large effect on the over - all performance (1.17) of the participants.

The features of the "Online GEM Reviewer" such as Study More, Review Time, Assessment, Formulas, Dictionary, Math Resources and What's App significantly contribute to the increase on the participants' performance. The Study More is a feature that allows the user to study and review additional topics or concepts on specific subject. After studying, the user can navigate the Review Time feature of the application. This feature, the user can review different questions from different mathematics

subject. The unique part of this feature is the availability of the solution and explanation for each question. One of the best features of this application is the Assessment, where the users can assess their over-all performance in five different subject areas. In this feature, the user will answer randomly selected questions from equally represented subjects with time constraints. The Formula, Dictionary, and Math Resources are additional features of the application. The user can use these features if they forget the exact formula or the definition of a specific word/s and can use or browse other mathematics books available in the application. The last feature is the What's App, this feature talks about the application itself and sources of the application.

While the participants were using the GEM Reviewer, it was observed that: 1.) time allotment was not an issue in the review sessions since the application can be accessed anytime, anywhere at the convenience of the user; 2.) user-friendly, easy-to-navigate, engaging and fast-to-load features 3.) teacher monitoring is not necessary because the application has a self-monitoring feature. In a series of observations, the research successfully established the framework to positively impact the learning and performance. These observations and feedback from the participants are inquiry-based factors that we should consider in using an effective online reviewer. The studies of Arbain & Shukor [41] and Mautone, DuPaul, & Jitendra [42] provide evidence on the effectiveness of the software in helping the students understand the topic easily and in arousing their interest to learn mathematics. Studies revealed that different learning methods used in delivering the topics helps the students to improve their mathematics performance such as inquiry-based learning [25] and cooperative learning [43].

The result of the study confirmed the findings of Kokotsaki et al. [27], Duffy & Raymer [28], Friesen & Scott [29], and Saunders-Stewart et al. [30], that Inquiry-based learning method helps in improving mathematics performance of the students. Moreover, results positively confirm the study of Furió et al. [18], Al-Jewair et al. [19] and Looi et al. [20] that using mobile phone application in teaching helps the students understand the topics.

Table 3. t-test for Pre-Assessment and Post-Assessment Mean Scores of the "Online GEM Reviewer" User's

Subjects Areas	Type of Test	SD	Mean	df	t - value	Effect Size (Cohen's d)	p - value
Fundamental of Mathematics	Pretest	3.37	6.18				
	Posttest	2.10	8.87	129	-9.43	0.96*	0.01*
Elementary Algebra	Pretest	2.79	5.85				
	Posttest	2.15	8.58	129	-11.20	1.20*	0.01*
Plane Geometry	Pretest	2.59	6.56				
	Posttest	1.84	8.58	129	-8.97	0.90*	0.01*
Probability	Pretest	2.10	4.74				
	Posttest	2.26	7.40	129	-13.92	1.22*	0.01*
Statistics	Pretest	2.04	6.16				
	Posttest	2.13	7.97	129	-9.33	0.87*	0.01*
Over-all Performance	Pretest	11.12	29.49				
	Posttest	8.98	41.40	129	-13.62	1.17*	0.01*

*Significant at 0.05 level.

*Large Effect at 0.8 Cohen' d value.

4. Conclusions and Recommendation

Based on the preceding findings that undergone comprehensive data treatment and analysis, the Inquiry Based Online GEM Reviewer positively influence the mathematics performance of graduating teacher education students. Furthermore, education teacher, instructors, reviewers, and others may design and develop other hybrid method and techniques that they can embed in the technology platform. Additionally, the researcher encourages the conduct of similar studies in different subject areas or specialization of LET. Additionally, the researcher suggests in using the two groups Pretest-Posttest Quasi-experimental design.

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