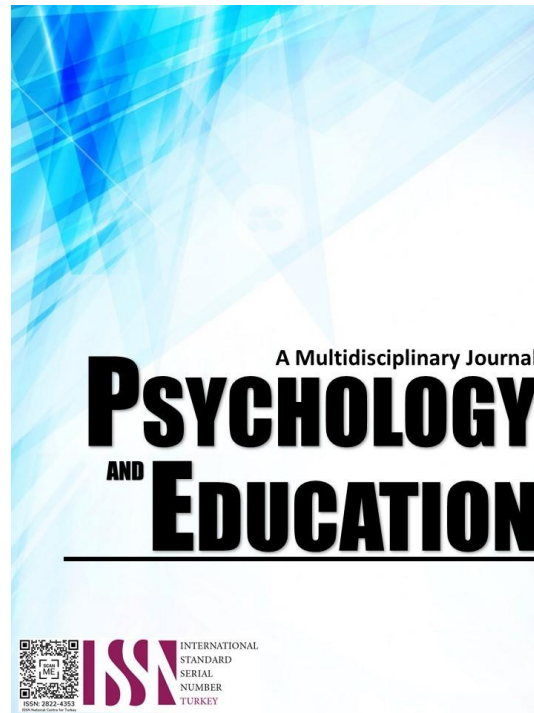


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Integrating 7E Instructional Learning Cycle in Developing Instructional Material Using Google Site in General Mathematics

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Abstract

This study aimed to develop and evaluate an instructional material through Google Site in General Mathematics for senior high school students of Marist School during the school year 2022 – 2023. Specifically, the study sought answers to the following questions: (1) What General Mathematics Topics were included in the development of an instructional material through Google Site based from the least mastered topics identified by the mathematics teachers? (2) What was the evaluation of the mathematics teachers and the expert teachers on the instructional material through Google Site as regards content, instruction, comprehensibility, and technological aspect? (3) Was there any significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the abovementioned material? (4) What were the comments and suggestions of the evaluators for the improvement of the instructional material developed? This study used the descriptive method of research. The researcher developed the instructional material with an integration of 7E instructional learning cycle through Google sites which was then assessed and evaluated by fifteen (15) mathematics teachers and fifteen (15) expert teachers who are teaching in selected secondary schools in Marikina City. The data gathered in this study were treated statistically using ranking, weighted mean, and independent-samples t test. The major finding for this study is, there was no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics. Thus, the material was deemed acceptable and appropriate for the target learners.

Keywords: *google site, 7e mode, instructional material, distance learning, general mathematics*

Introduction

The rapid global breakout of the COVID-19 pandemic, which predominantly affected the health sector, is one of the most significant human occurrences ever. Its consequences are still clearly visible at this time, forcing other industries to find a creative way to carry on with their processes. As mentioned in the Sustainable Development Goals Report (2020), the education sector was one among the ones most impacted by the pandemic's escalation. "Many schools are offering remote learning to students through virtual classrooms to mitigate the impact of school closure" (p. 33). This shows that switching from face-to-face to distance learning was the primary choice of education departments worldwide to prevent students' extended absences from class.

In the Philippines, the Department of Education (DepEd) have employed several modalities and one of which is known to be as Online Distance Learning (ODL) (Combo & Bugay, 2021). ODL was one of the suggested distance learning modalities by the DepEd, as stated in DepEd Memo DM-CI-2020-00162, which was published in July 2020 (Duero, 2020). ODL was described on the same memo as "...a learning delivery modality where the teacher facilitates learning and engages learners' active participation using various technologies connected to the Internet while they are

geographically remote from each other" (p. 6).

Presently, as the outbreak became more manageable and on-site classes are now underway, most people expect that modalities during distance learning will no longer be an option. In contrary to this, former DepEd Secretary Leonor Briones (2022) insinuated that blended learning, especially in technology, communication, and digitalization will still be implemented. The ideal strategy for improving teaching and learning outcomes is to give students access to many learning environments. It can be executed by merging two separate learning techniques, such as in-person instruction and online instruction (Muhtia, et al., 2018).

However, there are several research that showed underlying challenges during the implementation of the aforementioned modality. Learners that took part on the study of Dahmash (2020) ran into issues connected to technologies, teachers' role, online assessments, and limited learner's resources. As suggested by Chiu (2021), that in order to address learners' expertise and cognitive load, the technological learning environment, including the Learning Management System (LMS) and learning resources, must be designed.

While the execution of competency- or outcomes-

based blended education is thought to require intentional and detailed planning, teaching becomes inherently difficult. Hence, given the fact that mathematics is an extremely abstract subject in and of itself, the idea becomes somewhat more difficult as it is presented within the context (Esguerra & Combo, 2021). As one of the subjects discussed via online learning, mathematics needs a lot of preparation to ensure that the materials presented to learners meaningfully and easy to understand, especially in high school, which contains abstract topics (Yohannes, et al., 2021).

“An effective mathematics teacher is one that does not only know mathematics deeply but also knows a lot about the teaching of mathematics,” (Framework for Philippine Mathematics Teacher Education (FPMTE), 2011, p. 25). This emphasizes the idea that, being an excellent mathematics teacher is not solely based on how they understand the content, but also, on how they could transfer it to the learners the best way possible. Furthermore, it was concomitantly established in FPMTE (2011) that teachers are challenged in several ways. To be more precise, it was highlighted that, “...we find that mathematics teachers are tested by the existence of various types of technologies and their rapid advancements and the perceived disconnect between school mathematics and everyday life...” (p.1). This goes to show that in order to address this identified technological gap among Mathematics, mathematics teachers, and learners, there should be a step that needs to be initiated to systematize these leading factors and would strengthen the mathematics education in a general perspective.

Consequently, the present researcher initiated to fill in the abovementioned gap through recognizing the need of having a learner’s instructional material with contents that are technologically and pedagogically appropriate to mathematics learners. Relative to the idea of ensuring that a material will be of quality and standard-based, it should be supported by the FPMTE (2011) which will be further discussed on the latter portion of this study.

Apart from the Mathematical Pedagogical Content Knowledge (PCK) introduced by FPMTE (2011), this research also considered the integration of technology in the development of the proposed instructional material which makes it technologically-based. Hence, it took into account the Technological Pedagogical Content Knowledge (TPACK) Framework. TPACK has become a clear and practical foundation for researchers trying to comprehend how technology is incorporated into learning and teaching (Baran et al., 2011). Thus, educators have the freedom to select how

to best implement technology in teaching and learning processes.

To fulfill the requirement for the development of a technologically-based material, the researcher utilized Computer-Aided Design (CAD) as its primary design. This material could cater students’ needs throughout the implementation of the blended learning modality. Specifically, CAD introduces Computer-Assisted Instruction (CAI) as one of its key components whereas, it is used to describe drill and practice, tutorial, or simulation activities that are provided independently or in addition to conventional, teacher-led instruction (Cotton, 1991). Stronger student involvement was produced as a result of the major impact that digital support had on how the LMS as a CAI platform was viewed in terms of autonomy, competence, and relatedness (Chiu, 2021).

As regards the constructive alignment of the proposed material, a specific cycle should be taken into consideration. There are various learning cycle models that are usually anchored to constructivism (Sam et al., 2018) and inquiry-based teaching approach (Hanuscin & Lee, 2008). Among these learning cycle models, the researcher of this present study utilized 7E Model, which is considered a “higher model than 5E” (Gönen et al., 2006, p. 83), as the primary model of the developed computer-aided instructional material.

With regards to those mentioned concerns, this research aimed to address the identified gaps which will be through the development of a computer-aided instructional material in the form of Google Site that is grounded to FPMTE (2011) and TPACK as the major frameworks and 7E Learning Cycle as the primary model for the presentation of the content. To ensure the validity and reliability of this material, underwent series of evaluation in terms of its content, instruction, comprehensibility, and technological aspect.

Research Questions

To be more specific, this study sought answers to the following questions:

1. What General Mathematics Topics were included in the development of an instructional material through Google Site based from the least mastered topics identified by the mathematics teachers?
2. What was the evaluation of the mathematics teachers and the expert teachers on the instructional material through Google Site as regards:
 - 2.1 Content;
 - 2.2 Instruction;
 - 2.3 Comprehensibility; and

2.4 Technological aspect?

3. Was there a significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the abovementioned material?
4. What were the comments and suggestions of the evaluators for the improvement of the instructional material developed?

Literature Review

The shift of modality is undeniably challenging (Lapitan, Jr. et al., 2021). It poses several areas of opportunities to both students and teachers for not everyone has the capacity to adapt to abrupt changes. Additionally, Flores et al. (2022) alluded that due to the pandemic, unanticipated shifts in the teaching method from in-person instruction to online distance learning created difficulties for mathematics teaching and learning. With regard to this, various educational institutions resorted to the employment of blended modality instead of implementing full online learning sessions since it is believed to be more prone to some logistical issues (Gerold, 2020). On the same article, the author emphasized that asking questions during online classes is much more difficult compared to when it is done on the usual set-up which is somewhat alarming since according to H.O.P.E Education (2021), asking good questions is said to be an important skill that contributes to one's holistic learning.

In reference to the present study, these ideas shared by the preceding literature imposes relevancy for it underpinned the current construct which is about the challenges brought by the sudden shift of the modality, may it be online or blended.

Apart from the problems focusing on the lesson delivery, it was also brought up that learners' resources had insufficiency on numbers and on its ability to meet the students' academic needs (Rotas & Cahapay, 2020; Combo et al., 2022). Along with this, Scharaldi (2020) underscored on her educational blog that additional chances for students to see and engage with mathematical ideas are made possible by technology. By utilizing games, simulations, and technological tools, students can explore and discover new things.

By taking these ideas into account, development of an instructional material that is technology-based will be a good step towards targeting the goal of having sufficient number of materials that is appropriate to the technological needs of the learners. This corroborates

the objective of the present study, more so it strengthens that reason why it is important to produce a computer-aided instructional material for the mathematics subject.

As defined by Wawasan Open University (n.d.), computer-assisted (or aided) instruction (CAI) describes education or remediation delivered using a computer. Also, it added the claim the CAI significantly improves the instructional qualities of teachers and learners. Further, it was explained by Training Industry (2022) that, through the combination of graphics, text, video, and audio upgrades, CAI provides a presentation of materials that is interactive. It is frequently used as a tool to facilitate training, and it can improve user experience and raise participation. That being so, integrating CAI to the system of education will obviously provide a substantial impact considering that it is already 21st Century, whereas, technology is very evident everywhere.

As established on the report of Ito et al. (2022), it was implied that CAI has a great deal of potential to raise learners' mathematics test performance in the near- and maybe longer-term. Not only that, Bonsu et al. (2020) used other related studies to arrive to a conclusion that CAI had a positive impact with respect to the academic achievement of the learners in contrast to the usual set-up of teaching-learning processes. These advantages of CAI ascertains that the present researcher is on the right track as regards to that solution to be formulated which shall eventually reconnect the previously mentioned gap and other things that hinder the smooth flow of instruction.

Yenilmez et al. (2008) included in their literature the construct established by Tall (1986) that there is a common belief that software designed for learning is usually practical. They supposedly make mathematics very clear, according to another claim. Software should be able to display the results of numerous computations as well as the mathematical method and steps used to arrive at the solution to the problem. Hence, the same study stresses that in ensuring that mathematics will be taught properly using CAI, an appropriate learning cycle model should be taken into utmost consideration.

The academic success of learners is significantly impacted by the employment of learning cycle models in the educational process (Sarac, 2018). This supports the idea that in order for a learners' material to be constructively aligned, it should follow a model that would guide both the learners and teachers in achieving their primary goal, which is to make sure



that the competencies are truly learned and taught. As introduced, there are several learning cycles that are very common when it comes to the implementation of the lesson. For this present study, 7E learning cycle will be utilized. Teaching resources utilizing the 7E learning cycle might assist students in comprehending the issues and occurrences they meet in their surroundings (Amini & Usmeldi, 2020).

7E Model is the expanded version of 5E model, and by adding two new phases to the first and last phases, it is one of the most popular and well-known instructional models used today (Turgut, 2017). Further, Yenilmez et al. (2008) elaborated the model's instructional phases which are:

Elicit. The main goal of this phase is to bring up prior learning experiences and establish a solid foundation for subsequent phases. It can be argued that supporting the thinking abilities is lacking when starting with only engaging the new issues with the oldies. Hence, we should restore outdated knowledge and educational opportunities.

Engage. Learners are encouraged to reflect on the lesson and come up with their own questions. Questioning, describing a problem, and mind-storming in challenging situations are typical actions associated with this phase.

Explore. Learners get the chance to exercise their critical thinking skills in this phase as they explore their knowledge and schema. Moreover, they should be further encouraged for deviating from the core issue and providing justification for developing their own schemas.

Explain. In this stage, it's crucial to manage scientific notions connected to the subject. In order to provide alternate responses to inquiries concerning the issue, students should have a structured thinking. Additionally, fresh ideas can be introduced by the time they have new ideas within the context of their observations during the investigate phase.

Elaborate. Students reflect more deeply on the material they study and use it in many contexts. The teacher in this phase must demonstrate important skills including showing empathy for lessons and broadening students' understandings.

Evaluate. The learning cycle model gives teachers specific opportunities to assess students' learning rates and track their progression in thinking levels. For instance, in addition to more conventional tests like quizzes, evaluation components like idea maps,

projects, and summary reports regarding the subjects might be used.

Extend. Bransford et al. (2000) as cited by Yenilmez & Ersoy (2008) explained that the purpose of introducing this new phase to the elaborate and evaluation phases is to demonstrate to the teachers that using some classic and current assessment methods should not be the last step and to highlight the significance of the many applications for information transfer. As it appears to the instructional material developed by the researcher, a set of terminologies were utilized. These are: (a) Diagnostic Activities (Elicit) which contains the pre-test and initial activities to test the prior knowledge of learners; (b) Building Blocks (Engage), a part where the learners will be encouraged to reflect on the lesson and come up with their own questions; (c) Freedom Wall (Explore), the phase that gives learners a chance to exercise their critical thinking skills and develop their own ideas; (d) In Action! (Explain), the abstraction part where the teaching and learning are centered in; (e) Let's Get Real (Elaborate), a portion to which learners are expected to appreciate the real-life applications of every topic; (f) Test Yourself (Evaluate), the part the instructional material that assesses the overall learning of the students regarding the topics involved; and lastly, (g) Enrichment Activities (Extend), one of the learning cycles that ensures continuity and gives learners an opportunity to look beyond the content.

In addition to having a solid grasp of mathematics, teachers should be able to organize classroom mathematics lessons and divide them into absorbable learning units. This principle is presented as part of the Framework for Philippine Mathematics Teacher Education (FPMTE) (SEI-DOST & MATHTED, 2011) which inculcates that mathematics teachers also need to understand, along with the what, the why and how of the subject.

Another principle of the above-mentioned framework imposes that "Mathematics is best learned when students are actively engaged" (p. 6). To optimize their learning potential, the learners must take on the duty of being actively involved on the discussion and promote the idea of independence and autonomy. An additional construct that FPMTE had coined, hence one of the most relevant to this present study was, "Technology plays an important role in the teaching and learning of mathematics. Mathematics teachers must learn to use and manage technological tools and resources well" (p. 7). As per the objective of this study, the teachers should be advanced with regard to the utilization of technologies even more so, on how it contributes to the



betterment of the teaching and learning processes.

As discussed by Castor (2019), teachers are expected to create learning experiences that are efficient and geared toward achieving organizational goals as members of the school community. Thus, one of their main jobs is to create and design programs that will meet the demands of the learners. In this regard, Edejer (2021) also established a related study focused on determining the impact of the developed eModule in Trigonometry for Grade 9 Mathematics as teaching materials at San Isidro National High School, Antipolo City for the fourth quarter of the school year 2020 – 2021. They used quasi-experimental research method and utilized a questionnaire to gather evaluation from fifteen (15) math experts and another fifteen (15) from math teachers. Another set of questionnaires were given to sixty (60) students who were selected by matched case-control design. Based on the findings, teachers and students can both benefit from the e-module as an effective teaching tool. Further, the emodules are comprehensively and rationally developed to assist students in meeting their learning objectives.

The goal of the study conducted by Rosali (2020) was to investigate the impact of introducing Computer-Assisted Instruction on the academic achievement of secondary physics students. The quasi-experimental pretest-posttest control group design was used in the study, which included 157 Grade 10 students from a private school in the Philippines. The experimental group was taught utilizing computer-assisted instruction, whilst the control group was taught using traditional methods of teaching Physics. The study's findings revealed that both CAI and traditional teaching approaches considerably increase students' physics ability however, it emphasized that the effectiveness of these methods did not directly affects students' achievement in the subject.

The studies conducted by Castor, Edejer, and Rosali are comparable to the present one since it accentuates on designing programs that are embedded to computer-based instructional materials. Thus, the only key difference among these three studies is mainly the subject area they highlight.

Speed (2020) reported on her dissertation that there are curriculum trainers who thought that CAI as a program lacks student engagement during learning sessions. This problem is very common most especially if the learner or the teacher is not fully equipped with necessary tools that this kind of instruction demands. More so, it is crucial that instructional strategies meet

students' needs and promote positive involvement in order to raise reading proficiency among children. In terms of mathematics, the level of numeracy skills of the learners also depends on the pedagogical approach of the teachers. It was supported by the study of Shin and Shim (2021) where they gave emphasis on the idea that enhancing students' cognitive and motivational growth depends largely on the effectiveness of the teacher and the classroom environment.

Another study that imposes similarity to the present one is the dissertation submitted by Julius (2018) where it was investigated how the use of Computer-Aided Instruction (CAI) affects the achievement, self-efficacy and collaborative skills of learners with regard to learning Chemistry as it is compared to other Conventional Instructional Methods. Correspondingly, principals frequently turn to computer-assisted learning programs in the hopes of achieving an immediate increase in growth in academic performance due to the need to provide teachers with individualized instructional programs that are engaging in order to show an increase in academic achievement, especially in the area of reading and mathematics, while minimizing the amount of planning time and resources needed (Thomas, 2018). Relative to the current study, the researcher tries to fill in the identified gap as it was found out that students' engagement is dependent to the instructional method employed by the teachers (Inayat & Ali, 2020), most especially in mathematics.

Aside from the sole impact of CAI to the students' academic status, Muchiri (2018) proved that gender can also be a prevalent factor that CAI has effect to. It was revealed that there is a significant difference between the effect of CAI to male and female learners. Likewise, it was shown on the findings of the study of Chen et al. (2020) that students who participated in computer-assisted instruction that included environmental education were able to find unique, engaging instructional materials online and showed a strong attachment to nature and to promote learning at the same time. These establish the idea – which is present to the current study – that CAI can be dominant in any area, especially if the involve are learners who are dependent to how teachers deliver his/her lessons. On that account, teachers who were accustomed to traditional teaching methods were also required to, despite their lack of technological proficiency, embrace technology as it becomes an integral part of lesson delivery (Barrot et al., 2021).

To sum up these concepts on CAI as established by

various academic documents, the researcher of the present study would like to reiterate that teachers need to be adaptable and flexible, thus, shifting to new methods of teaching should be treated as an inevitable change to the education system. However, this should also become an eye-opener to the administrators and other institutions, that teachers and learners are in need of support anent to the issue with regard the implementation of CAI as part of the system.

This study considered the hypothesis, there is no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics in terms of the content, instruction, comprehensibility, and technological aspect. Hence, the conceptual model that guided the researcher in conducting the study is shown in Figures 1, 2, and 3.

Methodology

This study made use of descriptive method of research. According to Creswell (2014), gathering data that describes occurrences is the first step in descriptive research, which subsequently organizes, tabulates, visualizes, and summarizes the data collection. In order to help the reader comprehend how the data is distributed, it frequently includes visual aids like graphs and charts. Meaning, the data that will be collected, such as the evaluation of the teachers on computer-aided instruction will be described, examined and interpreted.

Participants

There are 15 expert teachers and 15 mathematics teachers from selected secondary school in the Division of Marikina City with a total of 30 teachers who served as respondents of the study and were selected through purposive sampling. Purposive sampling is conducted when the researchers choose respondent who they believe will best help them in understanding the research problem and its specific questions (Creswell, 2014). They evaluated the developed instructional material by providing their assessment of its content, instruction, comprehensibility, and technological through a validated survey questionnaire.

Instruments of the Study

The instrument that was utilized in collecting the data for this research was a checklist-questionnaire for the

identification of the students' least mastered topics in General Mathematics and teachers' evaluation on the instructional materials that was validated by several experts. The questionnaire made to evaluate the developed instructional material contains four (4) component criteria which are Content, Instruction, Comprehensibility, and Technological aspect. A four-point scale was provided to indicate the degree or level of agreement for the evaluation of the respondents in each item. Each statement in the criteria was rated using 1 to 4 rating scales with the corresponding verbal interpretations: Fully Agree (FA), Strongly Agree (SA), Strongly Disagree (SD), and Fully Disagree (FD), respectively. For further specifications, scale 1 is ranging from 1.00 to 1.49, scale 2 is from 1.50 to 2.49, scale 3 is ranging from 2.50 to 3.49, and scale 4 is from 3.50 to 4.00.

As emphasized, this study was focused on the development and evaluation of a Computer-Aided Instructional (CAI) material in General Mathematics that is grounded to FPMTE (2011) and TPACK. It was previously mentioned that the material is composed of several parts, namely, Diagnostic Activities, Building Blocks, Freedom Wall, In Action!, Let's Get Real, Test Yourself, and Enrichment Activities. These parts were initially formulated for it corresponds to the phases of 7E structural cycle model. This CAI material aimed to fill in the gap, specifically the technological gap, as identified by several mathematics experts.

Procedure

Before the administration of the survey questionnaires to the selected mathematics and expert teachers, formal letters were sent to another set of content experts as it was initially validated and underwent necessary revisions based on their comments and suggestions.

After finalizing the survey questionnaire, the developed CAI material was forwarded to the chosen respondents who served as the evaluators of the material. Prior to this, the researcher sent letters of permission to conduct the study to the principals of the schools where the teacher-respondents teach. After the permission was approved, the data gathering procedure commenced. To conclude, the researcher ensured that all data gathered were treated with strict and utmost confidentiality.

The researcher made use of the following statistical tools:

Frequency Count, Percentage, and Ranking. This was



utilized in order to determine the significance of the evaluation of the subject teachers on the least mastered topics in General Mathematics.

Independent t-test. It assessed whether the means of the two groups are statistically different from each other. This was utilized to determine if there is a significant difference on the evaluation of the two groups of respondents on computer-aided instructional (CAI) materials as regards to the given areas.

Weighted Mean and Standard Deviation. It was used to determine the weighted mean of respondents' answers on the survey questionnaire which will be then used in determining the significant difference between the evaluation of the two groups. Moreover, the standard deviation was utilized to measure the spread of each scale value.

Results

This study aimed at the development and evaluation of a Computer-Aided Instructional (CAI) material in General Mathematics that is grounded to FPMTE (2011) and TPACK. After a thorough analysis of the empirical data, several findings were established.

As a result of the initial survey from the selected mathematics teachers, it revealed that there were three specific topics for each general content which are: Rational Functions (Representation), Rational Functions (Zeros, Intercepts, and Asymptotes), Rational Functions (Word Problem Solving), Compound Interest (Compounding more than once a year), Simple Annuity, General Annuity, Truth values and Tables, and Logical Equivalences. Further, these topics were used by the researcher as the basis for the development of the 7E-integrated instructional materials.

Tables 1 to 4 present the evaluation of the expert teachers and mathematics teacher-respondents on the developed instructional materials in General Mathematics in terms of its content, instruction, comprehensibility, technological aspect. Subsequently, the summary of the evaluation of the two groups of respondents is presented in Table 7.

Content. Table 1 presented the two groups of respondents' evaluations on the developed instructional material as regards content. It can be observed in the table that both groups fully agreed on the content of the developed instructional material as shown by the overall weighted mean of 3.72 and 3.83,

and standard deviations of 0.43 and 0.29, respectively.

Table 1. Respondents' Evaluations on Developed Instructional Material in Terms of Content

Indicators	Respondents			
	Teachers		Experts	
	WM	VI	WM	VI
The contents are aligned with the competencies in the curriculum guide.	3.8	FA	3.93	FA
The content is valid and reliable with real-life applications.	3.67	FA	3.8	FA
The content includes 21st century skill development with technology as collaborative, creative teaching, literacy, and problem solving.	3.87	FA	3.87	FA
The content references other subject areas.	3.6	FA	3.73	FA
Lessons/Tasks present concepts in different ways allowing for a variety of responses.	3.67	FA	3.8	FA
Overall Weighted Mean	3.72	FA	3.83	FA
Standard Deviation	0.43		0.29	

Instruction. Table 2 showed the evaluations of the two groups of respondents on the developed instructional material in terms of instruction. It can be observed in Table 3 that both expert teachers and mathematics teacher-respondents fully agreed on the instruction of the developed instructional material as shown by the overall weighted mean of 3.67 and 3.84, and standard deviations of 0.46 and 0.25, respectively.



Table 2. Respondents' Evaluations on Developed Instructional Material in Terms of Instruction

Indicators	Respondents			
	Teachers		Experts	
	WM	VI	WM	VI
The teacher's orientation on the curriculum contributes to the effectiveness of their online teaching delivery.	3.67	FA	3.75	FA
Teaching and learning by the use of examples based from experiences (constructivism) were considered in making the lesson flow interactive and learner-centered.	3.62	FA	3.87	FA
The use of the materials is appropriate with the teaching-learning environment.	3.60	FA	3.89	FA
The instructions support learners and teachers for a successful technologically-integrated teaching-learning processes.	3.73	FA	3.80	FA
The material provides the teacher an easy access on students' data from assessments.	3.73	FA	3.87	FA
Overall Weighted Mean	3.67	FA	3.84	FA
Standard Deviation	0.46		0.25	

Table 3. Respondents' Evaluations on Developed Instructional Material in Terms of Comprehensibility

Indicators	Respondents			
	Teachers		Experts	
	WM	VI	WM	VI
The material models content that supports all types of learners.	3.80	FA	3.67	FA
The material presents options for meeting the individual needs.	3.73	FA	3.80	FA
The material satisfies various teaching styles.	3.80	FA	3.80	FA
The material presents opportunities for task-based learning.	3.80	FA	3.87	FA
The material offers remediation and continued learning.	3.67	FA	3.80	FA
Overall Weighted Mean	3.76	FA	3.79	FA
Standard Deviation	0.39		0.35	

Comprehensibility. Table 3 consists the evaluation of expert teachers and mathematics teacher-respondents on the developed instructional material about comprehensibility. It can be gleaned in table 6 that both groups of respondents also fully agreed on every indicator under the comprehensibility component of the developed instructional material as shown by the overall weighted mean of 3.76 and 3.79, and standard deviations of 0.39 and 0.35, respectively.

Technological Aspect. Table 4 showed the evaluation of the expert teachers and mathematics teacher-respondents on the developed instructional material with regard technological aspect. It can be seen in Table 4 that both expert teachers and mathematics teacher-respondents fully agreed on the evaluation on the technological aspect of the developed instructional material as revealed by the overall weighted mean of 3.77 and 3.85, and standard deviations of 0.37 and 0.26, respectively. The attainment of the subject standard and the improvement of student achievement are both aided by comprehensive teaching and learning materials (Edejer, 2022).

Table 4. Respondents' Evaluations on Developed Instructional Material in Terms of Technological Aspect

Indicators	Respondents			
	Teachers		Experts	
	WM	VI	WM	VI
The material allows the users to navigate through it without difficulty.	3.87	FA	3.93	FA
The material is engaging and interactive.	3.67	FA	3.87	FA
The material used graphics and multimedia that are suitable to the topics.	3.73	FA	3.87	FA
The material is device-friendly (accessible using any digital device).	3.87	FA	3.87	FA
The delivery method utilized in the design is used appropriately and successfully engages the students	3.73	FA	3.73	FA
Overall Weighted Mean	3.77	FA	3.85	FA
Standard Deviation	0.37		0.26	

Table 5 introduced the synopsis of the evaluation of



the two groups of respondents on the developed instructional material in terms of its content, instruction, comprehensibility, and technological aspect. As reflected in this table, the evaluation of the two groups of respondents had the same evaluations of the developed instructional material in terms of content, instruction, comprehensibility, and technological aspect as revealed by the grand weighted mean of 3.73 and 3.83, respectively.

Table 5. Summary of Respondents' Evaluations on the Developed Instructional Material

Criteria	Respondents			
	Teachers		Experts	
	OWM	VI	OWM	VI
Content	3.72	FA	3.83	FA
Instruction	3.67	FA	3.84	FA
Comprehensibility	3.76	FA	3.79	FA
Technological Aspect	3.77	FA	3.85	FA
Grand Weighted Mean	3.73	FA	3.83	FA

Significant Difference Between the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics.

The computed results of the difference between the evaluations of the expert teachers and mathematics teacher-respondents on the developed instructional material in General Mathematics are shown in Tables 6 to 9 and the summary in Table 10.

Table 6. Test of Difference Between the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics with Respect to Content

	Respondents	
	Teachers	Experts
	OWM	VI
n	15	15
OWM	3.73	3.83
s	0.43	0.29
Computed t Value	0.80	
Critical t Value	2.05	
Decision	Fail to Reject H_0	
Interpretation	Not Significant	

As observed in Table 6, the computed t value of 0.80 is smaller than the critical t value of 2.05 with 28 degrees of freedoms. At 5% level of significance, the statistical decision is not to reject the null hypothesis. Therefore, this indicates that there is no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics as regards content.

Table 7. Test of Difference Between the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics with Respect to Instruction

	Respondents	
	Teachers	Experts
	OWM	VI
n	15	15
OWM	3.67	3.84
s	0.46	0.25
Computed t Value	1.27	
Critical t Value	2.05	
Decision	Fail to Reject H_0	
Interpretation	Not Significant	

Table 7 displayed that the computed t value of 1.27 is below the critical t value of 2.05. Thus, the statistical decision is to fail to reject the null hypothesis. At 5% level of significance, this supports that there is no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics in terms of instruction.

As shown in Table 8, the computed t value of 0.20 is less than the critical t value of 2.05. Hence, at 5% significance level, this leads that the null hypothesis cannot be rejected. Further, this means that there is no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics as regards comprehensibility.

Table 8. *Test of Difference Between the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics with Respect to Comprehensibility*

	Respondents	
	Teachers	Experts
n	15	15
OWM	3.76	3.79
s	0.39	0.35
Computed t Value	0.20	
Critical t Value	2.05	
Decision	Fail to Reject H_0	
Interpretation	Not Significant	

Table 9 revealed that the computed t value of 0.69 is lower than the critical t value of 2.05. At 5% significance level, the statistical decision is not to reject the null hypothesis. Consequently, this shows that there is no significant difference between the evaluation of the mathematics teachers and the expert teacher-respondents on the developed instructional material in General Mathematics on its technological aspect.

Table 9. *Test of Difference Between the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics with Respect to Technological Aspect*

	Respondents	
	Teachers	Experts
n	15	15
OWM	3.77	3.85
s	0.37	0.26
Computed t Value	0.69	
Critical t Value	2.05	
Decision	Fail to Reject H_0	
Interpretation	Not Significant	

Table 10 presents the summary of the decisions and interpretations of the evaluations of the two groups on the developed instructional material in General Mathematics with regards to its content, instruction, comprehensibility, and technological aspect.

Table 10: *Summary of the Decisions and Interpretations of the Evaluations of the Two Groups of Respondents on the Developed Instructional Material in General Mathematics*

Criteria	Decision	Interpretation
Content	Fail to Reject the H_0	Not Significant
Instruction	Fail to Reject the H_0	Not Significant
Comprehensibility	Fail to Reject the H_0	Not Significant
Technological Aspect	Fail to Reject the H_0	Not Significant

Discussion

The results showed that the content of developed instructional material is appropriate as evaluated by the expert teachers and mathematics teachers. Hence, it is determined to be aligned with the content standards, include valid and reliable real-life applications, hone 21st century skills of learners, cover different subject areas, and contain assessment tasks that are appropriate for different types of learners. This also implied that the developed instructional material shows clarity with respect to its process flow, technologically-integrated approaches, and cohesiveness on the implementation of the tasks and activities. In support for this, it was highlighted by Subia (2020) in their conducted research that the importance of learning exercises and activities can be attributed to its effectiveness in fostering students' interests, critical thinking, and problem-solving abilities. The developed instructional material is as well as generally comprehensive as evaluated by expert teachers and mathematics teachers whereas it poses learner-inclusivity, varied teaching styles, independent learning, and continuous monitoring and assessment. As revealed by the study of Combo (2018), a clear, differentiated, and patent instruction was a contributory factor to an inclusive learning as it makes learning much more meaningful, regardless of the utilized modalities. Lastly, the study is deemed effective on the integration of technology to the developed material to which it shows accessibility and interactivity. This concept is corroborated by the previously mentioned study of Julius (2018) where they gave emphasis on how technology-integration (thru CAI) improves students' achievement in specific subject areas.

Based on the tables, it recognizes that the content of the developed material is aligned with the national standard set by the Department of Education as introduced through K-12 Curriculum Guide, more

specifically, in Mathematics subject. Moreover, it goes to show that such material could be a valid instrument in making sure that teaching and learning will still take place despite the adjustments and challenges that the education system faces. It also has the capacity to promote teaching and learning across modalities. It presents instructions that are well-formulated and concomitantly appropriate to the learning environment of various learners. Moreover, it entails that the developed instructional material is inclusive by nature where it fits with different types of learners in the 21st century as it uses various approaches of teaching methodology. Most importantly, the results convey that technology is well-integrated to all areas of the developed material and is utilized to promote accessibility in teaching and learning.

Conclusion

This study aimed at the development and evaluation of a Computer-Aided Instructional (CAI) material in General Mathematics that is grounded to FPMTE (2011) and TPACK. Based on the results of this study, the conclusions derived were:

(1) the developed instructional material in General Mathematics with an integration of 7E instructional learning cycle using Google site is deemed acceptable in terms of its content, instruction, comprehensibility, and technological aspect. Thus, the material has met the necessary standards as revealed by the evaluation of the expert and subject teachers; (2) as evidenced by the evaluation of the group of respondents, the developed instructional material was able to meet the standard as regards integration of technology, which had previously been highlighted as a gap under the FPMTE (2011); and (3) the developed instructional material could be of a great assistance to learners and teachers of General Mathematics, whether it be through face-to-face or even more so, through the implementation distance learning modalities since it enables continuity of high-quality teaching and learning.

Furthermore, it is recommended that the developed instructional material may be utilized under full online and/or blended learning modalities. If in case there will suspensions of classes due to particular reasons, the material could also be employed to ensure that learning will still be continuous. Providing trainings and seminars for teachers on the integration of technology in teaching and learning process may be one of the major priorities of schools and other educational institutions.

To ensure inclusivity and standardization of instructions, similar type of material may be developed for other disciplines, with different instructional learning cycles, or even for specific set of learners. In addition, a separate content validator for the assessments parts of the material to guarantee its validity and reliability may be considered.

In essence, this type of material may contribute to the success of the implementation of Open High Schools throughout the Philippines since the program has been practicing distance education even before the pandemic. Taking into account various experts and topic teachers' comments and ideas, the material may still be improved, notably its interface and how the instructions be presented to guarantee that learning is in-depth and learner-centered.

Finally, further related research may be conducted focusing on other fields utilizing different theories, methodologies, frameworks, and other school contexts.

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