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Research Article

IMPROVING STUDENTS' ACHIEVEMENT, HABITS OF MIND, AND PROBLEM-SOLVING SKILLS THROUGH COMPUTER GENERATED INSTRUCTIONAL MATERIALS (CGIM)

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ABSTRACT

To effectively engage and teach students of this generation, teachers need to integrate technology into the classroom. Thus, this study aimed to determine the effects of the developed Computer Generated Instructional Materials (CGIM) in College Geometry on students' performance, habits of mind, and problem-solving of 108 College students from three different classes, specifically, 36 students from each class that used work text, slide text, and both as an intervention. The study utilized an 80-item performance test, 15-item habits of mind test, and a 20-item problem-solving test. Mean, standard deviation, ANCOVA, and Cohen's d were the statistical tools used. The result shows that before the intervention, students' performance was "average", habits of mind was "low", and problem-solving was "basic" regardless of the intervention used. After the intervention, students' performance shifted to "high" except for those who used both work text and slide text whose performance was "very high". Students' habits of mind shifted to "high" and problem-solving was "proficient" regardless of the intervention used. Significant differences also existed in the intervention used in favour of those who used both work text and slide text compared to those who used work text or slide text only. Thus, the researchers recommend using the CGIM to facilitate teaching and learning College Geometry. Thus, it is recommended to use a combination of slide text and work text to facilitate teaching and learning.

Keywords: Evaluation, Computer Generated Instructional Materials, Work text, Slide text, College Geometry, Students' Mathematics Performance, Habits of Mind, Problem-Solving.

BACKGROUND OF THE STUDY

State Universities and Colleges (SUCs) in the Philippines are mandated to fulfill the following three functions by the Commission on Higher Education (CHED): instruction, research, and extension. Instruction, which is the distribution of knowledge, takes center stage in any educational program, according to the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP). Research is a method for generating acceptable technologies as well as for discovering, using, or validating new knowledge. Extension entails using newly developed knowledge and technology produced by the institution to enhance people's quality of life (Ilupa, 2009). The function of Production is a built-in mandate for these three functions. The operations involved in converting inputs into outputs to produce commodities and services are referred to as production (Medina, 2014). Production involves applying theoretical concepts, learning skills, and information into practical settings situations. It can also assist in creating income to sustain the other three aforementioned functions (Wrenn & Wrenn, 2009). In line with this, created the University Publishing House and Bookstore in accordance with this directive. In reaction to R.A., the WVSU-UPHB was also established. The Book Publishing Industry Development Act, also known as No. 8047. This act entails that the book publishing business has an important role in national development since books are instrumental in the citizenry's intellectual, technological and cultural development, which represents the basic social foundation for the economic and social growth of the country. The best and most affordable means for advancing education, distributing knowledge, and documenting, maintaining, and promoting the nation's cultural legacy are books (RA 8047, n.d.).

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Effective mathematics instruction requires both knowing what students already know and still need to learn, as well as inspiring and aiding students in their study. Along with knowing and caring about their students as math learners and as people, teachers must be adept at choosing and employing a variety of pedagogical tactics and learning resources. Instructional resources frame classroom activities with text and diagrammatic representations and help teachers accomplish goals that they presumably could not or would not accomplish on their own (Joy, Tan-Espinar, & Ballado, 2017). Workbooks/work texts are frequently used in classrooms and are preferred since students can work directly in their books, according to Anderson (2003 in Joy *et al.,* 2017). Currently, there are no specific materials, be it in a textbook, workbook, or modules in tertiary education that would cater development of mathematical skills. With this, teachers are the one preparing their instructional materials. In order to address the needs of their learners, they contextualize their works. This is supported by the study of Cabiles (2022) which states that teachers should provide contextualized instructional materials in order to address the least-mastered competencies of their students. The need to contextualize is because the bulk of textbooks on the market are written by foreign authors, and their subject matter is unsuitable for Filipino students, the new curriculum for teacher education, and enhancing the teaching skills necessary for the K–12 curriculum. (Bacio&Sagge, 2019b). The knowledge, examples, and performance challenges necessary for a basic understanding of geometric concepts may be provided by the CGIM for college geometry. This was intended to complement and suggest uniformity of instructions rather than replacing the lessons that will be created by the teachers (Sagge&Bacio, 2019a). According to Westbury, textbooks and other printed materials are still thought to be the best instrument for enhancing the positive transfer of learning since they support a good human mentor to teach effectively and efficiently (1998 in Cruz, 2015). To encourage quality instruction and so ensure quality education, relevant materials that serve as the primary tool and store of common knowledge that schools convey, a basic instrument for designing curricula, and a basic tool for teaching and learning can be made available. Moreover, according to Wambui (2013), learning materials are important for gaining knowledge and mastering particular abilities. According to him, instructional resources are not created to become a substitute for an effective teacher or to replace the textbook but to supplement the educational process. Numerous research have demonstrated the efficacy of teaching tools, with Ghazi, Khan, Hussain, and Faitma's (2010) being one among them. A learning module, according to their research, is a set of self-study materials that covers one specific area of study. By selecting from a variety of presentation approaches, the learner can follow a learning sequence, select the appropriate content, and evaluate his or her own progress. The Pacific Policy Research Center (2010) also determined that curriculum standards must be supported by instructional resources that take into account students' needs as lifelong learners. More importantly, it must demonstrate excellent writing, production skill, and user-friendliness.

Moreover, Bacio and Sagge (2022b), the developed and produced multimedia presentation, if used in the classroom, could increase student learning and retention compared to "traditional" lectures or classes that don't use multimedia. Additionally, it presents the knowledge using visual and auditory coding, improving learner comprehension. The findings of Bacio & Sagge's study (2022a), which suggested that the use of slide text in the classroom could enhance learning by ensuring that students pay close attention to the material being taught, are supported by the findings of this study. Students' comprehension increases when the material is presented in a dual-coded manner using both visual and audio cues.

Finally, the study by Dillon-Marable and Valentine provides more evidence in support of the findings above (2006). They claimed that regular engagement between professors and students, the facilitation of technology use, and giving pupils the chance to use technology properly are all ways to successfully integrate technology into education. It is quite burdensome and does not directly assist lectures and instructor demonstrations when students are required to photocopy talks, book pages, and worksheets, many of which are overly onerous and oftentimes not necessary or related to the topics under discussion. Replicating complex tasks, such as definitions, theorems, postulates, conjectures, or assignments, requires a large amount of class time, just as doing so does. Since geometry is one of the subjects that students must be good at, it was taught in junior high and even primary school. The very purpose of this study is to provide evaluated teaching materials and maybe implement changes to enhance college geometry.

RESEARCH OBJECTIVES

The purpose of this study was to investigate the effects of CGIM and work text in college geometry.

Specifically, this study attempted to answer the following questions:

1. What level of performance, mentality, and problem-solving abilities did the students exhibit before and after exposure to (a) CGIM, (b) work text, and (c) CGIM and work text?
2. Does the performance, mentality, and problem-solving abilities of the students differ significantly after exposure to (a) CGIM, (b) work text, and (c) CGIM and work text?

METHODOLOGY

Research Design

This research was undertaken to determine the effects of producing CGIM and work text in College Geometry. The researcher used a quasi-experimental design, more precisely, the multiple-group design, to accomplish these objectives. According to Smith and Davis (2007), a multiple-group design is an experimental design that compares three or more levels or amounts of an independent variable. It can have a control group and two or more experimental groups or all groups are experimental since multiple-group design does not need to have a control group. Furthermore, the researcher needs to assure that: (1) the participants are matched on a variable that will affect their performance in the dependent variable, (2) each participant must participate in the treatment condition and (3) it may be limited by the size of the natural sets one intends to study.

To satisfy the conditions stated above, the researcher made sure that the three groups were comparable by using the pretest result. The intervention assigned to each group was randomly chosen through drawn lots. The design is illustrated below.

BEEd 3-A	O_1	X_1	O_4
BEEd 3-B	O_2	X_2	O_5
BEEd 3-C	O_3	X_3	O_6

Legend:

O_1, O_2 and O_3 Pretest	X_1 Treatment 1 (Work text)
O_4, O_5 and O_6 Posttest	X_2 Treatment 2 (CGIM and Work text)
	X_3 Treatment 3 (CGIM)

METHODS

Participants

The participants were the one hundred eight (108) third-year BEEd students from three different sections, specifically, thirty-six (36) students for each class. All one hundred forty (140) students from the three intact sections—45 from BEEd 3A, 48 from BEEd 3B, and 27 from BEEd 3C—were given a pretest to assess their level of performance, habits of mind, and problem-solving skills. The participants were also selected through a thorough match-pairing process based on their pretest performance, habits of mind, and problem-solving skill scores and rankings. The three groups were comparable as revealed by their pretest result which yielded no significant difference in mathematics performance [$F(2,104) = 0.139$; $p = 0.870 > 0.05$], habits of mind[$F(2,104) = 0.127$; $p = 0.881 > 0.05$], and problem-solving skills [$F(2,104) = 0.004$; $p = 0.996 > 0.05$]. The students were told not to write their names; instead, a research assistant was asked to randomly give them their individual examinee numbers during the pretest and posttest. This was done to protect the study from risks to internal and external validity. As a result, during the whole research procedure, their identities were kept a secret in relation to their ratings. Additionally, lessons for the three portions chosen were all scheduled in the morning and classrooms were far from one another to decrease the impact of extraneous variables. Delinquent participants were also excluded, along with their partners.

INSTRUMENTS

Mathematics Performance and Habits of Mind Test.

The test created for this study was based on the College Geometry course syllabus. There are 80 multiple-choice questions in the quiz. The questionnaire was evaluated by three faculty members from the Integrated Laboratory School and College of Arts and Sciences at West Visayas State University. The validation served as the foundation for instrument revisions and enhancements. The questionnaire also underwent pilot testing and a reliability test using the Kuder-Richardson 21 Formula, and the results showed that the test is reliable with a reliability coefficient of 0.8241. In this instrument, each of the correct answers was given a score of 1. The accumulated scores from the multiple-choice type were interpreted as follows:

Score	Interpretation	Description
64.01 – 80.00	Very High	The student has shown excellent understanding on the topics being discussed and exhibited outstanding completion of the assigned tasked.
48.01 – 64.00	High	The student has shown very good understanding on the topics being discussed and exhibited very satisfactorily completion of the assigned tasked.
32.01 – 48.00	Average	The student has shown good understanding on the topics being discussed and exhibited satisfactorily completion of the assigned tasked.
16.01 – 32.00	Low	The student has shown fair understanding on the topics being discussed and exhibited fair completion of the assigned tasked.
0.00 – 16.00	Very Low	The student has shown low understanding on the topics being discussed and exhibited poor completion of the assigned tasked.

The three-item proving problems were considered as habits of mind since proving was one of the areas considered under Geometric Habits of Mind (Driscoll, DiMatteo, Nikula, & Egan, 2007) and were also validated by the same experts. As practiced proving was written in two columns. The instrument for proving was a combination of guided proofs wherein some of the statements and reasons are already given and an open proof where students have the freedom to arrange write their proof. One point is given for each correct answer. Students' levels of mathematical habits of mind before and after the intervention were assessed using their answers in the pretest and posttest in proving problems. Their habits of mind scores were interpreted as follows:

Score	Interpretation	Description
12.01 – 15.00	Very High	The students have carefully identified and addressed essential facets of the issue, and they have used facts and pertinent evidence to support their arguments.
9.01 – 12.00	High	important components of the issue have been identified and addressed, and arguments are supported by relevant facts and evidence.
6.01 – 9.00	Average	Identified and addressed some aspects of the problem and developed a proof and reasoning using inappropriate opinion and were irrelevant
3.01 – 6.00	Low	Identified only the aspect of the problem and developed invalid proof and reasons.
0.00 – 3.00	Very Low	Not able to identify any proof and reasons to the problem.

Problem Solving Skills Test

The test was composed of five items on problem solving. The same valuators from the above instrument validated the problem-solving skills test. Four points was given for each problem. Students' problem–solving skills levels before and after the intervention were assessed using rubrics adapted from Vuelga (2017) and these were: four (4) points was given if answer had complete and correct solutions, showed complete understanding of the concept and used efficient and effective strategy to solve the problem, three (3) points if answer had incomplete solutions, substantial understanding of the concept and used effective strategy to solve the problem, two (2) points if answer had incomplete and incorrect answer, had some understanding of the concept, and used strategy to solve the problem, and one (1) point if answer was wrong, had limited understanding of the concepts and did not use strategy to solve the problem. The problem-solving scores were classified as follows:

Score	Interpretation	Description
16.01 – 20.00	Advanced	The students have thoroughly used effective strategy, understood mathematical concepts and presented complete correct solutions.
12.01 – 16.00	Proficient	The students have used effective strategy, understood mathematical concepts and presented correct solutions.
8.01 – 12.00	Approaching Proficient	The students have used some effective strategy, understood mathematical concepts, and presented correct solutions.
4.01 – 8.00	Basic	The students have used little strategy, understood mathematical concepts, and have not presented complete and correct solutions.
0.00 – 4.00	Novice	The students have no strategy, and incorrect solutions.

Intervention

The researcher aimed to apply CGIM in teaching college geometry in order to alter the conventional style of instruction. To meet the demands of the students, the teacher must modify several teaching methods. There is no one right approach to instructing a certain group of students in a class. For this reason, the researcher used the usage of CGIM as an intervention to ascertain whether this helps pupils perform better, develop habits of mind, and solve problems.

The experimental group was exposed to intervention for 7 weeks from January 29 to March 16, 2018. All lessons were aided by CGIM, work text, or both CGIM and work text that depend on the intervention assignment. In the University where the researchers are teaching, classes for College Geometry were twice every week at 1.5 hours every meeting. At the end of every meeting, a short quiz and problem sets were given. The summary of the topics and the CGIM used is shown below. After seven weeks of intervention, the groups are again given a posttest to determine if there was an improvement in the student's performance habits of mind and problem-solving skills.

Table 1: Summary of Intervention Used in the Study

Week	Meetings	Topic	Intervention Used	
			Pretest	
			Work text	CGIM
1	1 2	Chapter 5 Topic 1 - 3 Chapter 5 Topic 4 - 5 Chapter exam	pp 190-198 pp 199-205	Slide text, audio and video clips on quadrilaterals
2	1	Submission of problem sets Performance Task 6: Kite Flying	p 206	Slide text containing guide questions and instruction on kite flying
	2	Chapter 6 Topic 1 - 4	pp 208-226	Slide text, audio and video clips on similarity
3	1	Chapter 6 Topic 5 - 8 Chapter exam	pp 227-250	
	2	Submission of problem sets Performance Task 7: How Tall is a Tree?	p 251	Slide text on construction of how tall is a tree?
4	1 2	Chapter 7 Topic 1 - 4 Chapter 7 Topic 5 - 7 Chapter exam	pp 254-263 pp 264-274	Slide text, audio and video clips on Circles
5	1	Submission of problem sets Performance Task 8: Paper Plate Dream Catcher	p 275	Slide text containing instruction and rubrics in paper plate dream catcher
	2	Chapter 8 Topic 1 - 3	pp 254-263	Slide text, audio and video clips on plane coordinate geometry
6	1 2	Chapter 8 Topic 4 - 6 Chapter 8 Topic 7 - 9	pp 264-298 pp 299-2307	
7	1	Chapter exam and submission of problem sets		
	2	Performance Task 9: In the Black Square	p 309	Slide text containing instruction and rubrics in in the black square
			Posttest	

Procedure

The researcher informed the participants that they would take part in a study about using CGIM, work text, or a combination of the two before the study was conducted. After this, the researchers administered the pretest to the participants of the study. The results of the 80-item multiple-choice, 15-item habits of mind, and 20-item problem-solving skills test were analyzed to determine the pairing and who will be the participants of the study. The researcher used CGIM, work text, and both CGIM and work text to a particular section as a tool in order to facilitate learning. During the lesson, the researchers acted as facilitators who guide and monitor students' performance. The same topic, Quiz, chapter test as well as assignment were given to the students. They only differ as to the type of intervention used.

Each student received a post-test that was identical to the pretest but the items were rearranged. The researchers utilized the students' pre-test and post-test results to calculate how well the pupils performed after the intervention.

RESULTS AND DISCUSSION

Levels of Mathematics Performance, Habits of Mind, and Problem-Solving Skills

As shown in Table 2, the pretest means scores in the mathematics performance test of students who used CGIM (*M* = 41.97, *SD* = 6.66), both work text and CGIM(*M* = 41.36, *SD* = 6.38), and work text (*M* = 41.17, *SD* = 7.20) all indicate "average" mathematics performance. This means that the student has shown a good understanding of the topics being discussed and exhibited satisfactory completion of the assigned task. This also implies that the student's conceptual understanding was average previous to the intervention or that they might not have come across notions on the topic being covered. However, the posttest means scores of students who used the CGIM (M = 58.64, SD = 9.27) and work text (M = 56.72, SD = 11.35) both reflect "high" mathematical performance. While students who used both work text and CGIM have a "very high" (*M* = 67.44, *SD* = 6.03) mathematics performance. High performance means that after the intervention, the students have shown a very good understanding of the topics being discussed and exhibited very satisfactory completion of the assigned tasked. Meanwhile, very high performance means that after the intervention, the student has shown an excellent understanding of the topics being discussed and exhibited outstanding completion of the assigned task. It can also be observed that the mean gain for those who used the work text was 15.55, those who used CGIM had a better mean gain which was 16.67, and those who used both work text and CGIM had the largest mean gain, which was 26.08.

Table 2: Pretest and Posttest Scores in Mathematics Performance, Habits of Mind, and Problem-Solving Skills Exposed to Work text, CGIM, and Both CGIM and Work text

	Pretest				Posttest				
	N	SD	M	Interpretation	N	SD	M	Interpretation	Mean Gain
Mathematics Performance									
CGIM	36	6.66	41.97	Average	36	9.27	58.64	High	16.67
Both	36	6.38	41.36	Average	36	6.03	67.44	Very High	26.08
Work text	36	7.20	41.17	Average	36	11.35	56.72	High	15.55
Habits of Mind									
CGIM	36	3.06	5.11	Low	36	2.41	11.89	High	6.78
Both	36	3.10	5.44	Low	36	1.33	11.94	High	6.50
Work text	36	2.57	5.36	Low	36	1.98	11.78	High	6.42
Problem Solving									
CGIM	36	2.56	4.94	Basic	36	2.79	14.08	Proficient	9.14
Both	36	2.80	4.92	Basic	36	2.36	15.78	Proficient	10.86
Work text	36	2.66	4.89	Basic	36	2.24	13.47	Proficient	8.58

Note: Performance- 80.00-64.01 "Very High", 64.00-48.01 "High", 48.00-32.01 "Average", 32.00-16.01 "Low", 16.00-0.00 "Very Low"

Habits of Mind- 15.00-12.01 "Very High", 12.00-9.01 "High", 9.00-6.01 "Average", 6.00-3.01 "Low", 3.00-0.00 "Very Low"

Problem Solving- 20.00-16.01 "Advanced", 16.00-12.01 "Proficient", 12.00-8.01 "Approaching proficient", 8.00-4.01 "Basic", 4.00-0.00 "Novice"

Moreover, table 2 show the pretest mean scores in habits of mind test of students who used CGIM (*M* = 5.11, *SD* = 3.06), both work text and CGIM(*M* = 5.44, *SD* = 3.10), and work text (*M* = 5.36, *SD* = 2.57)all indicate "low" habits of mind. This means that the students have identified only the aspect of the problem and developed invalid proof and reasons. On the other hand, the posttest means scores in habits of mind test of students who used CGIM (*M* = 10.44, *SD* = 1.38), both work text and CGIM(*M* = 11.03, *SD* = 1.38), and work text(*M* = 9.69, *SD* = 1.70) all indicate "high" habits of mind. This indicates that following the intervention, the students have recognized and addressed crucial components of the issue and use appropriate facts and evidence to defend valid proof and reasons. It can also be observed that the mean gain for those who used both work text and CGIM was 6.50, those who the work text has a better mean gain which was 6.42 and those who used the CGIM has the largest mean gain, which was 6.78. Furthermore, table 2 shows the pretest mean scores in the problem-solving test of students who used CGIM (*M* = 4.94, *SD* = 2.56), both work text and CGIM (*M* = 4.92, *SD* = 2.80), and work text (*M* = 4.89, *SD* = 2.66) all indicate "basic" problem-solving skills. The students have used little strategy, understood mathematical concepts, and have not presented complete and correct solutions. On the other hand, the posttest means scores in the problem-solving test of students who used CGIM (*M*= 14.08, *SD* = 2.79), both work text and CGIM (*M* = 15.78, *SD* = 2.36), and work text (*M* = 13.47, *SD* = 2.24) all indicate "proficient" problem-solving skills. This means that after the intervention, the students have used effective strategies, understood mathematical concepts, and presented correct solutions. It can also be observed that the mean gain for those who used the work text was 8.58, those who used CGIM had a better mean gain which was 9.14, and those who used both work text and CGIM had the largest mean gain, which was 10.86. Based on the findings, it was generally noted that the intervention caused the students' mean scores to improve. This outcome can be linked to the students' innate ability as well as the novelty of the employed technique, which inspired the students to pay attention, learn, and study more. It was also clear from the students' engaged participation in the conversation. Furthermore, because the posttest counted for 25% of their final grade, the students were quite driven to do well on it. This claim was backed up by studies of Lipnevich and Smith (2008), Stan (2012), and Krawczyk (2017) where grades are a very sound source of motivation.

Differences in Mathematics Performance, Habits of Mind and Problem-Solving Skills

Table 3 show ANCOVA result on the difference in the pretest and posttest scores on Performance**,** Habits of Mind, and Problem-Solving Skills Exposed to Work text, CGIM, and Both CGIM and Work text. It can be gleaned in the Table 3that significant differences existed in the mathematics performance of the students (F $(2,104)$ = 18.216, p = 0.000). The Bonferroni Procedure further revealed that no significant difference existed in the mathematics performance of those who used work text and those who used the CGIM (p = 1.000). However, a significant difference existed in the mathematics performance of those who used both work text and CGIM with those who used only the work text (p = 0.000) and who used both work text and CGIM with those who used only the CGIM (p = 0.000). In addition, the effect size of 0.259 implies a small effect, which also means that using both work text and CGIM is a little more effective than using work text or CGIM only.The findings validated the results of the study previously done by Guven, Aydin - Guc & Ozmen (2016), Mthethwa (2011), Umameh (2011), Hirvonen, Tolvanen, Annola&Numi (2012), Janssen, Erkens, Kirschner & Kanselaar (2012), Obodo (2012), Polat, Yavuz & Tunc (2017), Bush (2009), Choi and Dobbs-Oates (2014), and Fukuta (2012). All of them agreed that mathematics related activities, dynamic tasks and word problem types, using motivational instructional activities and different teaching strategies positively affect students' mathematics achievement.

Moreover, Table3 show that significant differences existed in the habits of mind of the students (F $(2,104)$= 7.149, p = 0.001). The Bonferroni Procedure further revealed that no significant difference existed in the habits of mind of those who used both work text and CGIM with those who used only the work text (p = 0.290) and who used both work text and CGIM with those who used only the CGIM (p = 0.116). However, a significant difference existed in the habits of mind of those who used both work text and CGIM and those who used the CGIM (p = 0.001). In addition, the effect size of 0.121

implies a small effect, which also means that using both work text and CGIM is a little more effective than using CGIM only. Eventually, the students developed the habituated characteristics of habits of mind (Goldenberg, 2009; Driscoll, 1999) after series of practice activities in proving as confirmed in the studies of Mason and Spence(1999) Lim (2008) and Watson and Mason (2007). Furthermore, Table 3 shows that significant differences existed in the problem solving skills of the students ($F\ (2,104)$ = 8.323, p = 0.000). The Bonferroni Procedure further revealed that no significant difference existed in the problem-solving skills of those who used work text and those who used the CGIM (p = 0.896). However, a significant difference existed in the problem-solving skills of those who used both work text and CGIM with those who used only the work text (p = 0.014) and who used both work text and CGIM with those who used only the CGIM (p = 0.000). In addition, the effect size of 0.138 implies a small effect, Duru, *et al.,* (2011), Zarei, Pourghasemian, and Jalabi (2017), Ernst, Glennie, and Li (2017), Joji & Kikas (2016), and Lein, Jitendra, Starosta, Dupuis, Hughes-Reid, and Star (2016). All of them conform that different mathematical tasks and problem–solving strategies were effective in generating powerful mathematical thinking in building adequate problem representation and inferences that provide the basis for learning.

Table 3: ANCOVA Results on the Difference in Pretest and Posttest Scores in Mathematics Performance, Habits of Mind, and Problem Solving Skills Exposed to Work text, CGIM, and Both CGIM and Work text

	Sum of Squares	df	Mean Square	F	Sig	Effect Size
Mathematics Performance						
Contrast	2386.225	2	1193.113	18.216*	0.000	0.259
Error	6811.709	104	65.497			
Habits of Mind						
Contrast	32.256	2	16.128	7.149*	0.001	0.121
Error	234.608	104	2.256			
Problem Solving						
Contrast	102.736	2	51.368	8.323*	0.000	0.138
Error	641.846	104	6.172			

* p < .05

CONCLUSIONS

Based on the study's findings, using instructional materials—such as a work text, CGIM, or both—can help students become better in mathematics and develop better study habits and problem-solving techniques. One of the greatest teaching methods is the combination of work text and CGIM because it targets the senses of sight and hearing while concurrently addressing more than one sense. Moreover, work text and CGIM is a complementary material, which is needed to facilitate the teaching and learning process and it ensures the active involvement of students in learning. Giving challenging activities like proving and problem solving can help enhance students' mathematical skills especially since these were placed in the work text so the students can easily review their lesson. Thus, the CGIM is highly needed in schools as a tool for retaining interest and increasing students' motivation to learn mathematics.

Recommendations

The researcher's CGIM should be used as course materials, according to the curriculum designer. Additionally, the outcome can provide curriculum designers with the foundational data they need to suggest using supplemental teaching resources like the CGIM. In order to facilitate teaching and learning, the school administrator should encourage its teachers to try using CGIM. Additionally, it will give administrators ideas for how to finance or invest in the growth and creation of CGIM for their teachers. The developed and produced CGIM should be used by the teachers because it has many benefits, including improving student test scores, reducing the time needed to prepare exercises and drills for the students, and ensuring that students do not find math classes to be out of date because we live in the age of modern technology.

Since there are enough drills and activities in the established and produced CGIM for the learners, who are the study's primary beneficiaries, they are encouraged to use it. They can each have their own work text, so they can each work at their own pace and even undertake advance study. Since the information is contained in the work text, they don't need to gather all the handouts that were provided. They can use it as a reference for their license exams or when they are already teaching in the field, making reviewing and studying easier. Other researchers may be inspired by this work to undertake comparable research on different age groups and topics.

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