Artificial Intelligence-Powered Calculator Application Usage in Mathematics Summative Assessments

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Abstract- The prevalence of students' usage of artificial intelligence-powered calculator applications (AI-PCAs) and academic dishonesty in distance learning significantly impacted the validity and reliability of the mathematics summative assessment results. The issue indicated that students might have difficulties acquiring the required knowledge and skills as the mathematical lessons complexify over time. Consequently, the study utilized a quantitative, descriptive-comparative research design to determine the level of AI-PCA usage in math summative assessments. The 50 respondents were selected using stratified sampling and contacted to answer the online survey questionnaires using Google Forms; most were first-year students, while the minority were from the second year. Also, more respondents were taking online classes than offline. The gathered data were analyzed using frequency, percentage, mean, standard deviation, and analysis of variance (ANOVA). The findings revealed that the mathematics-major students from a Catholic tertiary institution demonstrated a high AI-PCA usage in math summative assessments and academic dishonesty in distance learning, regardless of their year level and learning modalities; these indicators were tested: different mathematics areas, activities, and student achievement motives. Being in distance learning while dealing with the difficulties brought by mathematics-related courses and problems must have led them to have a high AI-PCA usage. Such findings posited the formulation of a framework of policies concerning AI-PCA usage in an instructional classroom, which would involve the mathematics subject area coordinator, math teachers, and students. The research findings would aid in salvaging the future of mathematics education and securing the validity and reliability of math summative assessment results.

Indexed Terms- Academic Dishonesty, Mathematics, Policies and Guidelines, Mobile Applications, Distance Learning

I. INTRODUCTION

The higher the score, the better, and various students hold this notion, compelling them to resort to artificial intelligence-powered calculator applications (AI-PCAs), such as Photomath, Symbolab, and Mathway. This case is prevalent during online learning; some students use AIPCAs for academic dishonesty. Thence, using AIPCAs in math summative assessments poses problems as students might not learn the concepts and struggle as math lessons complexify. Assessment results might not also be valid. Realistically, these applications and their constant progression make cheating effortless. It is futile for teachers to find ways to fight this losing battle; however, teachers may beat the abusive usage of AI-PCAs by formulating policies in an instructional classroom.

A study in Norfolk, Virginia, showed that virtual learning heightened academic dishonesty, with teachers hesitant about student grades due to cheating using the Photomath app (Bellamy, 2021). The teachers perceived its usage as hindering genuine academic progress and doing a disservice to students who learn math honestly. However, according to Ozkan et al. (2021), while the unbefitting usage of AI-PCAs might hinder students from developing a concrete mathematical foundation, it must not be eliminated in math classes. When such calculator applications become available, the instructors shall also progress as the applications evolve and become more advanced.

Similarly, Moralista and Oducado (2020) stressed that the online learning transition increased cheating and plagiarism because of technological accessibility, resulting in difficulty in determining whether the students studied or completed the assigned readings; this paralleled the findings of Roman (2021) in the higher education and math contexts. Among the frequently used tools for cheating and copying the step-by-step solutions in math are the AI-PCAs. In the study of Hadjinor et al. (2021), some students negatively perceived Mathway due to their discouragement from performing manual computations and thorough problem-solving, which might also be true for students using other AI-PCAs.

SunStar Davao even wrote an article on academic dishonesty that has become prevalent among many students regardless of their learning modality in distance learning (Perez, 2021). While news about cheating is not foreign, it has become more concerning since various groups on Facebook, a social media platform, have emerged, indicating many ways to cheat in distance learning. Thereupon, it is also likely for some students in Davao City to resort to using AI-PCAs in their math summative assessments, like those found on the global and national levels.

Now, various studies about AI-PCAs have already existed, but most focus only on their positive impacts; there is a lack of research on their usage in math summative assessments and the formulation of instructional policies. Succinctly, the aforenamed realizations were what the current study considered gaps that the researchers addressed. However, the need to better the entire teaching-learning process in mathematics, even during challenging times, propelled the need to conduct this study. Furthermore, this study gathered information on AI-PCA usage to formulate instructional policies, considering their advantages and potential drawbacks and highlighting the need for students and teachers to adapt to technological advances.

- *Rationale of the Study*

Students have prevalently used AI-PCAs in their math summative assessments and demonstrated academic dishonesty, particularly in distance learning, alarming the teachers and the validity and accuracy of assessment results and signaling the possibility of students having difficulties learning math concepts as the lessons progress; the aforenamed prompted the researchers to conduct the study, more so that the number of downloads of AI-PCAs has increased since the beginning of e-learning. These applications can perform simple to complex mathematical tasks across different mathematics branches, indicating why many students use AI-PCAs in their summative assessments. So, this study provided data to address the mentioned worries through the study output—the instructional classroom policies. The data gathered would be deemed reliable because the respondents were math-major students with depth and authentic experiences regarding AI-PCAs; the data taken from them were thoroughly analyzed to catalyze valid and credible results necessary to policymaking. Furthermore, implementing policies on AI-PCA usage in math summative assessments would be beneficial and imperative in ensuring students can use them responsibly to optimize learning.

Kenas (2021) stated that AI-PCAs might help students excel in math, but, like any other tool, they might be a double-edged sword. Some have expressed skepticism about the utility of AI-PCAs due to various problems it poses—like it encourages academic dishonesty among students when taking assignments, quizzes, or examinations (Bellamy, 2021; Moralista&Oducado, 2020; Roman, 2021). Subsequently, Cox (2017) and Webel and Otten (2015) stressed the significance of establishing policies on their use, making the researchers seek to inaugurate policies to regulate AI-PCA usage. Proper statistical tools and methods were employed to analyze the collected data to substantiate the inferences and results (Ali & Bhaskar, 2016), which were critical to policymaking regarding the AI-PCA usage of the students, particularly those taking math-related courses and using math apps frequently during class instruction and math summative assessments. With the rise of technology in the 21st century, these AI-PCAs are just a click away from learners' grasp; it is already time to implement researched-based policies. Besides, Ozkan et al. (2021) emphasized that schools must develop and enact rules to regulate AI-PCA usage so that they get used for the benefit of the students and that abusive usage does not persist.

As a further consideration, the researchers aimed that this study would benefit the CHED, school administrators, the mathematics area, teachers, students, and future researchers in the mathematical field.

The Commission on Higher Education. CHED would find this study functional as this might serve as an additional guide for them to consolidate their policies and regulations beneficial in promoting relevant and quality higher education for all.

School Administrators. The school administrators might use this research study to strengthen their policies for stakeholders, especially the students, providing more quality teaching-learning processes.

Mathematics Area. This study would benefit the mathematics area because this could be a reference in implementing policies regarding AI-PCA usage in summative assessments, serving the best interest of teachers, students, and mathematicians.

*The Teachers.*The math teachers would benefit from the study, for its findings might be an eye-opener to concerns about academic dishonesty inside an online mathematics classroom. The study might help lessen the frustrations of the teachers about these cheating possibilities and worries that students would solely rely on the AI-PCAs rather than exert effort in learning math concepts, techniques, and processes. The teachers might use the study findings, output, and recommendations as a reference in establishing policies on AI-PCA usage inside the e-classroom. Thus, the study would help foster a healthy cause-and-effect relationship between the actions and consequences of students using AI-PCAs in math summative assessments.

The Students. Students, especially those taking math courses, would find this study functional since they could use AI-PCAs by adhering to guidelines and policies without disregarding the opportunity to improve their math skills. Furthermore, the study findings, output, and recommendations would allow the students to reflect on their learning and have a sense of responsibility and accountability for using AI-PCAs.

Future Researchers. Future researchers might use the study as their reference data, specifically when conducting studies regarding AI-PCAs. Moreover, future researchers might utilize the study when they focus on problems like academic dishonesty in distance learning or instructional classroom policies to lessen the amount of cheating and when they want to test the validity of other related findings. So, this study would serve as a cross-reference that would give future researchers an overview of AI-PCA usage, academic dishonesty concerns, and how these ideas and findings would serve as bases for instructional classroom policymaking.

II. STATEMENT OF THE PROBLEM

The study aimed to determine the level of AI-PCA usage in math summative assessments to provide a foundation for making solid, planned, and goal-directed instructional classroom policies. Specifically, the study sought to answer the following questions.

1. What is the demographic profile of the students in terms of:
   - 1.1. Year Level and
   - 1.2. Learning Modality?
2. What is the level of AI-PCA usage in math summative assessments in terms of:
   - 2.1. Different Mathematics Content Areas,
   - 2.2. Activities, and
   - 2.3. Student Achievement Motives?
3. Is there a significant difference in the level of AI-PCA usage when analyzed according to the profile of the students?
4. Based on the findings, what policies may the authorities implement concerning using AI-PCAs during classroom instruction?

Hypothesis

The following hypothesis got tested at a 0.05 level of significance:

H_0: There is no significant difference in the level of AI-PCA usage in math summative assessments when analyzed according to the profile of the students.

Theoretical Framework

This section discussed the theories that addressed the research problem. Accordingly, the researchers chose the artifact-centric activity theory (ACAT) of Silke Ladel and Ulrich Kortenkamp, the achievement motivation theory (AMT) of David Clarence McClelland, the anchored instruction theory (AIT) of John Bransford, and the constructivist learning theory (CLT) of Jean Piaget for their relevance and adequacy.

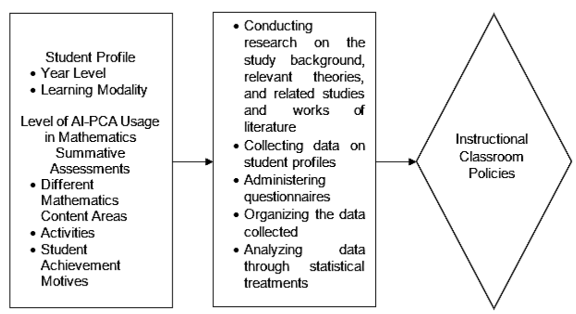
First, this study was anchored on the ACAT devised by Ladel and Kortenkamp (2016), which explored how AI-PCAs impact mathematics learning in a socio-cultural setting. ACAT consists of these five components: the subject (student), the group (other people), artifacts (AI-PCAs and the activities or operations doable using them), object (different mathematics content areas), and rules (systems from relevant disciplines). Forth, the artifacts mediated the activity between the subject and object, focusing on internalization and externalization processes. Thus, ACAT would guide the indicators of AI-PCA usage in math summative assessments and serve as the students' foundation to interact with the artifacts to determine their learning influences. As the students keep using AI-PCAs, their activities could be influenced, leading to internalized and externalized knowledge and mental representation.

This study further anchored McClelland's AMT, which pointed out that individuals have the desire to achieve excellence in their pursuits; these could be attaining a high level of success, mastering complex activities, and exceeding others (Lussier & Achua, 2015), although the needs of an individual would vary over time as their experiences would change (Majarhan, 2018). In the study context, the AMT guided one of the indicators of AI-PCA usage in math summative assessments: student achievement motives. These motives might includetaking calculated risks, accomplishing challenging goals, enhancing skills, formulating mathematical techniques, or getting high grades. Hence, AMT and student and teacher motives in using AI-PCAs in any mathematical tasks would aid in formulating goal-directed instructional policies.

Moreover, this study anchored the AIT of Bransford, whichfocuses on advancing meaningful contexts, authentic activities, and interactive videodisc tools, encouraging students and teachers to produce and solve complex, realistic problems (Shyu, 2000). The theory fosters independent learners and problem-solving skills, using “anchoring” orstories as mathematical problems that guide teachers in producing non-AI-PCA-ble exercises during classes. In this case, the AIT would motivate learners to investigate a story through a realistic narrative to generate and support their thinking skills.

Lastly, this study anchored Piaget's CLT, which claimed that people construct their knowledge through experiences and reflection (Bhattacharjee, 2015). In this regard, CLT would guide the study output—the instructional classroom policies—because of new concepts and apprehensions that students might master through the following: active learning activities (Wijers et al., 2010), immersion in real-world environments (Sommerauer& Müller, 2014), and learner-created contexts (Bray et al., 2013). By using AI-PCAs, learners could figure out the problem-solving process while building their understanding of all information they would encounter. Students would not rely solely on the applications but use them to enhance their comprehension.

Succinctly, the ACAT guided the two indicators of AI-PCA usage in math summative assessments: different mathematics content areas and activities; the AMT aided the student achievement motives; meanwhile, the ACAT, AIT, and CLT were vital for the reliability and foundation of formulating and establishing efficient instruction classroom policies for AI-PCA usage in math summative assessments.



Conceptual Framework

Figure 1. Conceptual framework showing the input-process-output of the study

Fig. 1 presented the conceptual framework of the study, which covered the following: its input based on the demographic profile of the students and the level of AI-PCA usage in math summative assessments; the process to address the problem and attain the objectives; the output, which was the proposed instructional classroom policies. Accordingly, the demographic profile included year level and learning modality. Then, the indicators of AI-PCA usage in math summative assessments comprised the different mathematics content areas, activities, and student achievement motives.

III. REVIEW OF RELATED LITERATURE

This section presented analyses of related literature and studies conducted by other researchers. It also showed the selected views and ideas of authorities that were relevant to the present study. Furthermore, the findings of the different studies and researchers were reviewed and discussed to provide a comprehensive background or perspective on the variables and their indicators.

AI-PCA Usage in Mathematics Summative Assessments

The ubiquitous use of AI-PCAs was a prominent aspect of the tech-savvy society, so it was unsurprising that many students, especially those struggling with math, turned to AI-PCAs to bridge the gap between the complexity of math and their mathematical abilities (Zhang et al., 2015). The Mathway application got more than 9 million monthly active users; this application solved more than 1.3 billion problems. Symbolab had over 200 million users worldwide, while Photomath had 6.5 million monthly users. Besides these three mentioned, there were more mathematical applications (Bitter & Corral, 2015): Graphing Calculator, Maths Solver, iMathematics, Unit Converter, Cymath, WolframAlpha, QuickMath, Microsoft Math Solver, Chegg Math Solver, MathPapa, Maple Calculator, Tiger Algebra, Gauthmath, GeoGebra, and the like.

The substantial number of users, including the recorded average number of problems solved monthly by these applications, indicated that various students frequently used AI-PCAs monthly. Studies also agreed that students frequently used AI-PCAs in completing their assignments (Gamage et al., 2020; Khan & Balasubramanian, 2012). Besides, the United Nations Children's Fund (UNICEF, 2021) mentioned that Filipinos frequently used Photomathto complete assignments when the pandemic started.

By all accounts, Kelecsényi et al. (2021) said that it was difficult to find studies focusing on the downsides of AI-PCAs, specifically when used for academic dishonesty. Most of them were only present in some online forums. However, the research of Bellamy (2021) and Williams (2020) provided lived experience of students using AI-PCAs in answering math assessments. Some articles and sites also stated that the existence of AI-PCAs is frustrating, particularly for teachers, since these applications have increased the amount of cheating (Newman, 2014; Posnick-Goodwin, 2020).

According to Ozkan et al. (2021), students, particularly those taking advanced math courses, utilized AI-PCAs to assist them in solving challenging mathematical tasks. The emergence of AI-PCAs negatively alarmed teachers (Posnick-Goodwin, 2020). The teachers became afraid that AI-PCAs would minimize the ability of students to think and solve mathematical problems and even abandon the role of math teachers in teaching and directing mathematical problem-solving methods (Watkins, 2021). The teachers could not help but think of how their students use AI-PCAs to cheat and gain higher scores in math classes. Besides, the availability of online learning options increased, thereby growing concerns regarding cheating in online courses (Raines et al., 2011).

Among the features of AI-PCAs were providing step-by-step solutions and answers to an equation, and the verbatim copying manifested academic dishonesty (Bellamy, 2021), particularly plagiarism. Some students modified the work of others to claim uniqueness and ownership of the answers. In Davao City, the Ateneo de Davao University (AdDU, 2016) and Holy Cross of Davao College (HCDC, 2020) considered such acts plagiarism and academic dishonesty. They defined *plagiarism* as claiming to own the idea or data of others, even when modifying a small portion. It could be plagiarism when there was no proper citing or referencing authorship. As part of the code of conduct for online learning, both institutions would not condone these behaviors. Even San Pedro College (SPC, 2019) regarded the usage of gadgets during examinations as cheating. With these in mind, using AI-PCAs for answering math summative assessments demonstrates academic dishonesty, which concurred with Bellamy (2021).

Even the article by Sung (2015) highlighted techniques that students used to exploit their accessibility to their mobile devices for cheating. There was a collaboration between the fine and performing arts faculty and the students in Baruch College to create a short video skit that allows professors to discern how students would cheat in the classroom using Photomath, an AI-PCA. According to Sung, the cheating techniques the students demonstrated were from their experiences.

Among the strategies included having one student distract the teacher for the other student to use Photomath, then the latter would ask permission to go to the restroom. During such time, the one who used the said AI-PCA could easily send the answers to other exam takers. The video skit also emphasized the possible impact of using AI-PCAs in math summative assessments (Sung, 2015). This impact focused on how the student who cheated got better grades than the student who took the exam honestly. So, the abusive usage of Photomath and other AI-PCAs also impacted the accuracy and validity of assessment results. While the article content of Sung (2015) focused on a real-life classroom setting, it held the prevalence of AI-PCA usage for academic dishonesty and its offsets on math assessments.

Subsequently, AI-PCAs were functional tools for providing accurate answers and solutions to various mathematical problems and equations (Hadjinor et al., 2021); they would lessen the effort of mathematical computations. However, students might rely on AI-PCAs to accomplish the mentioned tasks. Students might become complacent and rely solely on AI-PCAs to find answers and solutions rather than comprehend the mathematical concepts necessary to solve math problems (McDaniel, 2020), hampering them from developing their math skills to their full extent.
Meanwhile, in the study of Saundarajan et al. (2020), 36.4% out of 33 students strongly disagreed that they were aware of the existence of the Photomath application before the research was conducted; 21.2% disagreed; 18.2% remained neutral. In this case, many students were not frequently using Photomath and other AI-PCAs for math assessments, most likely, because they were oblivious that such applications exist and lacked exposure.

Furthermore, a study in Portland, Oregon, highlighted the student experience of using AI-PCAs. Most used the applications to answer their math assessments (Williams, 2020). The study findings showed that the students believed there would never be cheating in the mathematics-related courses despite copying the step-by-step solutions provided by AI-PCAs, for math problems did not have unique solutions (Williams, 2020).

Different Mathematics Content Areas
Hernawati and Jailani (2019) reported more than 4000 mobile applications for mathematics education. This emerging technology raised various questions in math education, so much so that a new term emerged due to mobile technologies. AI-PCAs were purchasable from smartphones, with many of these apps being free. A quick search of the iPhone app store would lead to popular AI-PCAs, such as Photomath, Mathway, Microsoft Math Solver, and SnapCalc. Many of these apps would use the smartphone camera to take a snapshot of the math problem and provide the solution. They manifested intelligence, thus making the students use AI-PCAs in Geometry, Algebra, Trigonometry, and other math-related courses.

However, there were inauspicious effects when using AI-PCAs, especially in mathematics summative assessment. Agbo-Egwu et al. (2018) concluded that the patterns of students' ability to recall basic mathematical facts, theorems, 65 axioms, and formulas indicated a negative influence of smartphone over-dependence on simple recall. They believed that the reliance on the Internet for simple recollection posed a significant threat to the future of mathematics. Additionally, they perceived that "the act of memorization in mathematics is a skill which must be developed and sustained for the very survival of mathematical prowess" (Agbo-Egwu et al., 2018).

One of the teachers interviewed by Posnick-Goodwin (2020)voiced their concern that some students who struggled in math during face-to-face classes turned in papers that surprisingly gained perfect scores when they switched to distance learning. In Algebra class, this teacher got frustrated that their students never watched the videos they made but still answered the assignments and activities using techniques and solutions never introduced and taught during the class. Then, they figured out that their students were using Photomath, which displays step-by-step solutions.

With these in mind, distance learning provided various temptations for academic dishonesty, especially when these AI-PCAs were always accessible.

Correspondingly, Peter (2021) emphasized that the transition to online learning elevated college students' ever-changing form of cheating to more than just a skill. As reported by Peter, more than 200 out of 800 students in Statistics 311 had been caught cheating and subjected to disciplinary action for using Chegg app in answering exam questions, which was known to provide answers to exam questions in their Statistics course. Thus, even if Chegg advertised its overall goal as a "tutoring service," it did not serve its intended purpose since the students used Chegg for academic dishonesty. While Chegg might provide some learning support for students who were genuinely learning at home, some students abused it for their sake.

A qualitative study by Williams (2020) found through an in-depth interview that out of 9 participants, three students admitted using math apps to answer their Trigonometry assessments. Williams determined that students use AI-PCAs to copy step-by-step solutions and answers to refrain from failing in class. The students also used AI-PCAs to finish their homework fast. Moreover, one student stressed that the course was irrelevant to their chosen degree program (Williams, 2020). Thus, the student thought it was trivial to take math seriously, for it was only a hindrance.

Furthermore, from the study by Watkins (2021), out of 77 willing respondents, only ten (10) were selected for an interview. One of the teachers from a public research university did not believe that an online set-up could work for math, particularly in their Pre-Calculus class, because they had significant issues with students cheating on online exams by using AI-PCAs. Thus, the teacher preferred giving in-person exams to ensure students had no phones. The teacher had to refer many students to the student misconduct office and had dismay while dealing with students' academic dishonesty (Watkins, 2021).

Activities

Merriam-Webster (2009) defined *activities* as an organizational unit that performs a specific function. Likewise, Collins Dictionaries (2020) determined activities as something a person can do. So, this study construed activities as what students do involving what AI-PCA could perform or operate.

There were many math-related applications available for students to use. In fact, like any other application, AI-PCAs were integrated with many activities to support students with their math assessments; they could also perform a specific function or operation depending on the preference or requisition of the user. Students taking mathematical courses got presented with AI-PCAs and websites that provided solutions for completing their math assessments (Bellamy, 2021). Students often used AI-PCAs like PhotoMath, Symbolab, and Mathway to complete their homework.

Some features of the mentioned applications include the following: reading and solving mathematical problems instantly by using the camera of the mobile device, providing step-by-step explanations on how to approach them, giving 2-D and 3-D graphs, and deriving other shape properties (Kenas, 2021). They are accessible and functional when students want to cheat; however, these calculator applications still have limitations (Kenas, 2021). The students need to pay for a premium subscription for more accessible features, and all the AI-PCAs still lack some skills that could surpass human abilities.

According to a published conference proceeding authored by Nguyen and Chen (2016), Photomath is an intelligent camera calculator integrated with an intuitive user interface involving reading math problems and equations using optical character recognition. Thus, the Photomath application is a point-and-click camera operation that lets the students scan the equations or any text and hand-written problems or equations and solve them instantaneously using a step-by-step process (Price et al., 2017). In this regard, Ozkan et al. stressed that since students might obtain the step-by-step solutions and graphs of a standard College Algebra problem in seconds by using AI-PCAs, the students might also "submit the correct solution to a problem without having any understanding of it" (2021). Without a doubt, this could be useful for those students who had difficulties in math-related courses.

Quick Graph is also another example of an AI-PCA emerging recently. The app displays graphs in both 2D and 3D. In addition to that, the generated graphs can be copied to the clipboard, emailed, and saved to photo libraries (Soule, 2016). Moreover, the apps include an "evaluate feature," allowing students to evaluate specific points in an equation and a library feasible for storing frequently used equations (Soule, 2016).

Furthermore, students used Mathway to deal with problems in their math classes, for this app allowed them to input any mathematical problems and get an answer instantly (Shelton, 2021). Some students used this app since it has a feature that provides solutions to an equation with an x-type problem. It can also expand logarithmic expressions, find exact values, simplify, or write any single logarithm. In addition, Mathway provides follow-up questions on which variable they want to solve (Shelton, 2021).

Student Achievement Motives

For a person to be motivated is to be compelled to act. The push or pull towards a goal induces people to initiate. In this context, a motive is an internal disposition that drives an individual toward a desired end-state in which the motive is satisfied (Souders, 2021). Turabik and Baskan have also stressed that the concept of motive brings the ideas of 'to motivate' and 'motivation' (2015). Accordingly, this study also measured the AI-PCA usage in math summative assessments based on the student achievement motive; this motive came from the human motivation theory of McClelland or "the three social motives" (Kurt, 2021).

Generally, the achievement motive is the desire to achieve a goal. This motive develops in an individual who has come across others within society obtaining higher levels of achievement, attaining prominent status, and setting high standards. This need for achievement can emerge from the social environment and socialization influences, such as having parents who encourage and value the pursuit and standards of excellence. However, achievement may also develop throughout life as a need for self-development toward complexity (de Andrade Baptista et al., 2021).

New applications, such as AI-PCAs, constantly emerge and substantially impact higher education (Peytcheva-Forsyth et al., 2018). Thus, the constant use of AI-PCA might lead to academic dishonesty among students (Peytcheva-Forsyth et al., 2018). Many students have violated academic integrity during assessments to obtain and maintain a higher score and avert failure (Abdaoui, 2018). With this in mind, Webel and Otten (2015) posed whether everyone should regard AI-PCAs as ideal tools for assisting learning or a perfect weapon for cheating.

Several reports also showed that using AI-PCAs in mathematics education improves student achievement in solving algebra problems in applied contexts, interpreting graphs, and general cognitive understanding (Chen & Lai, 2015; Parrot & Leong, 2018). The findings suggested that learners who use AI-PCAs over time may have a relative advantage in mathematical problem-solving and visualization of graphs.

Meanwhile, Williams (2020) stated that students used AI-PCAs to attain high grades and be part of the honors. Students with high GPAs believe they have multiple responsibilities and high expectations; consequently, they ought to think that the only way they can meet these expectations is to use math apps to complete their assignments quickly.

In this case, the desire for academic achievement is one of the reasons why students use AI-PCAs. In a study by Perry (2010), 27% of first-year students admitted copying answers and materials using math apps to complete their assignments since the AI-PCA availability lets them answer quickly, easily, and hassle-free.

Individuals want to compete with others to attain the desired goal in this situation (Reduan, 2014). This achievement motive drives students to improve their abilities and performance for success and a feeling of competence (Turabik&Baskan, 2015). This notion can be one of the reasons why students, especially those struggling and facing difficulties and challenges in accomplishing mathematical problems and tasks, seek to use AI-PCAs, such as Symbolab, Mathway, Cymath, Photomath, and other math apps frequently. They wanted to acquire the same level of academic achievement or even higher as their classmates (Williams, 2020).

Instructional Classroom Policies

Students usually hate mathematics and feel unmotivated toward the subject (Khan, 2012), thereby the solution of some tech-savvy teachers to incorporate mathematical applications in the classroom. According to Bitter and Corral (2015), teachers who use mobile applications during teaching-learning have students with more room for increased learning outcomes, motivation, and self-efficacy. As the world evolves, various applications that help learners with their studies become more available. In this regard, teachers must become effective and efficient facilitators of learning without solely settling on everything done in the past. Correspondingly, this support for the AI-PCA usage would call for appropriate policies in the instructional classroom.

Mead (2014) discussed how calculator dependence affects students in college. Many first-year college students have mathematical weaknesses that lead to errors in basic mathematical procedures rather than higher-level mathematics (Mead, 2014). Students also struggle to understand why the answers provided by AI-PCAs might be incorrect (Mead, 2014). Thus, the ability of students to perform simple tasks and mathematical problems without using calculators and other technology deteriorates as they become more reliant on such technology (Mead, 2014). If education aims to teach students what they need to know in the real world, educators must find a balance between technology usage and assessments (Mead, 2014). Such a balance might include finding ways for students to solve problems using AI-PCAs and perform tasks even without AI-PCAs.

Correspondingly, Ozkan et al. (2021) stressed the problems of having accurate assessments when using mobile applications or AI-PCAs, particularly when most have transitioned to online learning because of the pandemic. The possibility that students take too much advantage of the circumstances is there. So, the study provided suggestions for making assessments in which students may not find the answers using Photomath, Mathway, Symbolab, or any AI-PCA. In this case, the students would only have to rely on themselves while answering. These tips included the following: supporting students to acquire general math knowledge; asking simple conceptual questions and application problems; making connections between topics by unifying themes; including literal equations. Finally, Ozkan et al. (2021) encouraged teachers to embrace the availability of AI-PCAs and make them part of the relevant lessons.

Meanwhile, among those putting forward the significance of making and proposing instructional classroom policies in using AI-PCAs are Webel and Otten (2015). They provided three options for dealing in a world with Photomath. The first one is to ban access to Photomath; however, Webel and Otten (2015) also provided some drawbacks of this first option. These drawbacks include the students and teachers opposing each other and the assumption that students may always find ways to use this AI-PCA despite the banning.

Then, the second option is to restrict Photomath access. In this case, the students might use Photomath to deal with conceptual problems but not skill-based exercises. However, there are still downsides to this option. Like the first one, teachers and students might still oppose each other, for the latter is aware of this AI-PCA and may get frustrated not to use it. Correspondingly, Webel and Otten (2015) added another suggestion for the drawback—that the teachers might let the students use Photomath once the students demonstrate proficiency in solving equations. The last option provided by Webel and Otten (2015) is to consider a different division of labor. In this option, the students, not the teachers, decide when and how to use Photomath. The students will examine the Photomath before using it. Once the student deems Photomath appropriate to the activity, the student may use it; otherwise, the student might choose a different AI-PCA, like Symbolab or GeoGebra, for the mathematical task. The students might also let themselves deal with the task at hand. Webel and Otten also stressed that perhaps teachers require students "to spend too much time completing tasks better suited to tools such as PhotoMath and not enough time engaging in mathematics in ways for which human beings are especially suited" (2015, p. 372). Ultimately, the journal recalled the blog post, which is now updated, about the questions deemed "ungoogleable" (Mouldey, 2019); thereupon, Webel and Otten (2015) believed that it is time for instructors to start developing "unPhotoMathable" questions.

Synthesis

The AI-PCA usage in math summative assessments has become controversial among teachers, even among some authorities in the educational setting. Then, the researchers reviewed and analyzed the previous studies and literature about the phenomenon and sorted all the information. They found that AI-PCA usage in quantitative research has three indicators: different mathematics content areas, activities, and student achievement motives. These indicators were efficient for policymaking in an instructional classroom since a policy must serve the interest of the involved parties—the students and people thinking highly of the importance of gaining mathematical abilities and concepts. The findings also stressed the importance of policymaking. Thus, the study addressed the gap regarding AI-PCA usage in math summative assessments with the aid of the following: its indicators, theories, previous studies and literature, high regard for policymaking on AI-PCA usage in an instructional classroom, and the supplementary goal of providing additional data in the Philippine context, particularly Davao City.

IV. METHOD

This chapter thoroughly discussed the methods for achieving the purpose of the study; this covered the research design, respondents and sampling, research instrument, ethical consideration, gathering procedure, and data analysis.

Research Design

This study employed quantitative research, specifically the descriptive-comparative research design, to determine the level of AI-PCA usage in math summative assessments and formulate instructional classroom policies. According to Cantrell (2011), a descriptive-comparative research design is used to determine the relationship among variables and examine their differences. Since this research design propounds effectiveness in describing a phenomenon or a situation and scrutinizing how variables differed, it enabled the researchers to gather information and reach valid conclusions concerning the level of artificial intelligence-powered calculator application (AI-PCA) usage in math summative assessments. Furthermore, the quantitative, descriptive-comparative design produced inferences vital for instructional classroom policymaking.

Respondents of the Study

The research respondents were students taking Bachelor of Secondary Education (BSEd) and majoring in Mathematics in the second semester of 2021-2022 in a tertiary Catholic institution. The chosen respondents were selected because the students taking mathematics courses usually use AI-PCA (Bellamy, 2021). Some BSEd students who majored in Math experienced the issue in the study, so they provided credible and reliable data to the research, which was essential for formulating instructional classroom policies. Furthermore, the researchers used stratified random sampling to select the study respondents. According to Kaplan (2014), the stratified random sampling method is a probabilistic sampling option that splits the population into strata. The researchers utilized the strata to divide a population into important categories pertinent to the study purpose or when the researchers oversampled a particular small group of interest. Out of the 57 BSEd students who majored in Mathematics, the researchers only selected 50 respondents using Slovin's formula. They considered that when sampling a population, it was essential to utilize the said formula to calculate the sample size required to achieve a given confidence interval, and when they lacked information about the population behavior to determine the sample size befitting the study (Tejada &Punzalan, 2012).

Research Instrument

The researchers collected data using multiple adapted survey questionnaires from the report of Close et al. (2008), and the study of Brumberg (2007) and Elliot and Church (1997); these adapted survey questionnaires were relevant to the current research. Thereupon, the researchers took the modified items concerning the different mathematics areas from the report of Close et al., the activities from the study of Brumberg, and those for student achievement motives came from the study of Elliot and Church. According to Taherdoost (2016), the questionnaire is the most often utilized technique for data collection since its fundamental goal in research is to collect essential data most reliably and validly as possible. Consequently, validity and reliability, including the accuracy and consistency of the questionnaire, are significant aspects of the research methodology. The survey questionnaires also included items that collect demographic information, such as the respondents' year level and learning modality. Furthermore, the survey questionnaires underwent content validation from research professionals, notably research subject faculty members.

The researchers used a 4-point Likert scale. The options for evaluating the statement in the questionnaire were as follows: (1) Very Low, (2) Low, (3) High, and (4) Very High. Then, for the researchers to determine the level of AI-PCA usage in math summative assessments of the respondents, they utilized the scale and interpretation presented in Table 1.

Table 1. Numerical and Descriptive Equivalence of Level of AI-PCA Usage in Mathematics Summative Assessments Questionnaire

Weight	Range of Means	Verbal Description	Interpretation
4	4.00 – 3.00	Very High	This means that the level of AI-PCA usage in math summative assessments and academic dishonesty is very high in distance learning.
3	2.99 – 2.00	High	This means that the level of AI-PCA usage in math summative assessments and academic dishonesty is high in distance learning.
2	1.99 – 1.00	Low	This means that the level of AI-PCA usage in math summative assessments and academic dishonesty is low in distance learning.
1	1.00 – 0.99	Very Low	This means that the level of AI-PCA usage in math summative assessments and academic dishonesty is very low in distance learning.

Ethical Consideration

This section discussed the ethical considerations and guidelines the researchers practiced and employed throughout the study course. Forthwith, the researchers followed the ethical guidelines formulated by the Philippine Health Research Ethics Board (PHREB, 2017). The measures that the researchers took, the nine ethical considerations, were parallel to the aims of the PHREB. The researchers provided a balance between the research aims and the students as the research respondents; along with the imperative of conducting the study, the researchers protected and respected the rights and roles of the respondents.

Social Value. The study findings would benefit several entities: the Commission on Higher Education (CHED), school administrators, math teachers, students, and fellow researchers. First, the study would benefit the CHED since this would serve as an additional guide to consolidate regulations beneficial in promoting relevant and quality higher education in math classes. Second, the school administrators would find this study helpful because the findings would help implement policies to strengthen their services toward their stakeholders, such as the students and teachers. Third, teachers would benefit from this study because the findings and recommendations would alleviate their worries about students committing academic dishonesty in math summative assessments. The policies would help regulate AI-PCA usage and lessen the possibility of students abusing and relying heavily on these applications. Fourth, students taking math courses would perceive the findings as advantageous because they could utilize AI-PCAs to advance their mathematical skills while reflecting on their learning and taking responsibility and accountability for the appropriate AI-PCA usage. Lastly, fellow researchers would deem the study valuable because they could use the findings as a cross-reference once they research AI-PCAs, academic dishonesty concerns, and instructional classroom policies relevant to the mentioned issues.

Informed Consent. The informed consent forms were essential as a pre-requisite to data gathering since they aimed to promote the right of the respondents as autonomous beings to guarantee that the researchers would treat them with justice, benevolence, and respect. In this case, the respondents could participate freely, not under duress. In this study, the respondents received an informed consent form; these forms were sent by the researchers online through Messenger or Gmail before the respondents answered the survey questionnaire and took part in the data gathering. It was also affixed on top of the survey questionnaire to remind the respondents about their rights and foster mutual respect and fairness, with the main goal of allowing the respondents to make a sound decision about whether to participate in the study; thereupon, the researchers ensured the comprehensibility of the information. The researchers informed the respondents of the study's purpose, the significance of its findings, any potential negative consequences to their participation, and who could access the Google forms they filled out. If a respondent became distraught during their participation, the researchers guaranteed that they would provide additional information befitting the respondent. The respondents had the right to withdraw anytime without reason and cost. The informed consent forms assured the respondents that their decision would not affect their engagement in future services and their relationships with any researchers or research bodies involved.

Risk, Benefits, and Safety. The researchers prioritized the research respondents' rights, safety, and well-being. All research activities could pose some risk to the well-being of everyone involved, so the researchers addressed the potential harms, especially physical harm; they ensured that the respondents would not be at risk of contracting the coronavirus disease because the researchers administered the survey questionnaires online through Google Forms. Likewise, the researchers objectively discussed the benefits of the study for the respondents before the latter answered the survey questionnaires. The respondents would benefit from the present study and its findings because they could use AI-PCAs by following guidelines and policies while at the same time taking advantage of the opportunity to strengthen their mathematical skills. Additionally, the study's findings, output, and recommendations would allow the respondents to reflect on their learning, bear responsibility, and accordingly act when using AI-PCAs.

Privacy and Confidentiality of Information. The confidentiality of information gathered from the respondents was of the utmost importance to the researchers; therefore, the researchers secured the information obtained from the respondents throughout the research. Since the respondents filled out their answers in Google forms, it was encouraging that Google took pride in protecting both the Google accounts of the respondents and researchers from the following: unauthorized access, alteration, disclosure, or destruction of information. Google employed encryption and provided various security features, such as security checkups and two-step verification. Also, Google protected the account used by the researchers, and a solid password was provided to prevent access from any individual not part of the research team. By all accounts, Google and the researchers' solid password helped safe-keep the respondents' answers. Then, after analyzing the information gathered from the respondents, the researchers permanently deleted them to ensure that their content would never recover. The researchers also vowed that all the information gathered from the respondents would be for research purposes only. Withal, the researchers never failed to inform the respondents regarding all the rights they had to participate in the study.

Justice. The researchers used the stratified sampling method to select the study's respondents. Also, the respondents were chosen based on the study criteria: the respondents must be 18 and above and enroll in the degree program Bachelor of Secondary Education and major in Mathematics. The researchers ensured that the respondents got treated with dignity and equal respect, especially during the data gathering. The researchers upheld all the statements stipulated in the informed consent forms and recognized the respondents' valuable contribution to the study's success. The researchers thanked the respondents for their time and effort and mentioned them in the acknowledgment portion of the research paper.

Transparency. Communication could promote transparency; consequently, the researchers remained open and honest with the people involved in the study to foster a culture where information could flow freely. The researchers provided a hard-bound copy of the research study for future researchers to reference when they conduct their research in the same field. Moreover, the researchers were upfront when asked to present the study findings in discussions and forums. On the other hand, if any conflict of interest arose, the researchers remained professional and upheld mutual respect.

Qualifications of the Researchers. The researchers took Bachelor of Secondary Education and majored in Mathematics; they all enrolled in the course Research in Mathematics. They believe that they have abundant knowledge in the mathematics field and are well-equipped to conduct a research study focusing on AI-PCA usage in math summative assessments and formulate policies for its usage in the instructional classroom and math summative assessments.

Adequacy of Facilities. The researchers humbly asked the respondents about their most convenient time to answer the survey questionnaires and the ease of access to resources and devices like laptops, mobile phones, and a good and stable internet connection. It was essential to have these queries since they were vital in obtaining and gathering student responses. The respondents answered the survey questionnaires in the comfort of their homes for their safety; it was also to follow the health and safety guidelines amid the pandemic.

Community Involvement. The researchers assessed the preferences and diversity of the respondents in terms of academic goals, gender identity, year level, and age to earn their trust and credibility. The researchers believed that scrutinization and effective communication might help them gain full access to this vital component in research conduct. The essential element was for the respondents to develop an in-depth understanding of the study to provide valid, credible, and meaningful information throughout filling out their answers to the survey questionnaires. Also, the researchers ensured that they showed respect towards the respondents and guaranteed that the questions and choices written on the survey questionnaire were impartial and did not discriminate against anyone, whether their gender, academic proficiency, or culture.

Data Collection

The researchers observed and followed these stages to gather the needed information. First, the researchers asked the school administrators, teachers, and students' permission to conduct a study and survey BSED students who majored in mathematics. Second, the researchers sent an email through Gmail—comprising an advance notice and informed consent—to the prospective respondents to respect their rights and roles and ensure a high response rate. Third, the researchers administered the survey online. After the first mail, they disseminated the survey forms through Gmail or Messenger and gave the students a week to answer the questionnaire. The survey questionnaires produced through Google form contained confidential questions; thus, all names and information remained confidential. Lastly, the researchers retrieved the survey questionnaires containing the data needed for the analysis and interpretation.

Data Analysis

The researchers analyzed the data using various statistical tools— frequency, percentage, mean, standard deviation, and analysis of variance (ANOVA). The researchers utilized frequency to organize and summarize the student demographic profile, allowing them to observe the entire data conveniently. Then, the percentage determined the required number of respondents; it was a valuable method of expressing the relative frequency of survey responses and other data. Meanwhile, the researchers used the mean and standard deviation to assess the spread of scores or the distance of responses from the mean and estimate the level of AI-PCA usage during math summative assessments. The standard deviation and the mean had a specific relationship; the latter indicated the average value, whereas the standard deviation demonstrated the average spread of values around the mean (Andrade, 2020). Furthermore, the researchers used ANOVA to identify whether the means of the data groups were statistically significant. Hence, this tool allowed the researchers to determine the significant difference in the level of AI-PCA usage when analyzed according to the student profile.

V. RESULTS AND DISCUSSION

The study aimed to determine the level of AI-PCA usage in math summative assessments to provide a foundation for solid, planned, and goal-directed instructional classroom policies. In this case, presented in this chapter was a detailed discussion of the statistical analyses of the study, including the significance and implications of the numerical data. Each research question was addressed with supporting evidence from previous studies and literature.

Demographic Profile of the Respondents

Presented in Table 2 was the demographic profile of the stratified respondents in terms of their year level and learning modality. These respondents were students from a tertiary Catholic institution taking BSEd and majoring in Mathematics. The data was organized and summarized using frequency and percentage. The researchers used frequency to organize and visually represent the number of respondents coming from each year level and learning modality. Meanwhile, the percentage was used to determine how many of the total respondents belonged to each indicator categorized under the demographic profile.

Table 2. Profile of the Respondents

	Indicator	F	%
Year Level	First Year	16	32.0
	Second Year	6	12.0
	Third Year	15	30.0
	Fourth Year	13	26.0
Total		50	100.0
Modality	Online	35	70.0
	Offline	15	30.0
Total		50	100.0

As presented in the table above, the study had the highest frequency and percentage of respondents from first-year students; 16 participated in the survey, making up 32 percent (32%) of the total respondents. On the other hand, the second-year students provided the lowest frequency and percentage of responses to the survey; six responded, making up 12 percent (12%) of the total respondents. Meanwhile, out of the total respondents, 15 third-year students made up 30 percent (30%), and 13 fourth-year students made up 26 percent (26%). Then, 35 or 70 percent (70%) of the total respondents took classes using the online learning mode, while 15 or 30 percent (30%) chose the offline mode. Overall, the study was conducted with 50 respondents.

In this case, most of the respondents were in the first year, while the minority were in the second year. Also, more respondents used the online learning modality than the offline ones. Overall, each group in terms of year level and learning modality was well-represented to provide reliable data analysis for the level of AI-PCA usage in math summative assessments and significant differences in the respondents' year level and learning modality. The stratified sampling method also aided this study in providing valid and credible results for making and establishing efficient instructional classroom policies.

The study appeared to have such findings on the demographic profile in terms of year level; conversely, from the study of Khan et al. (2020), the highest frequency and percentage were from second-year students, making up 40.21%, while the first-year students were the lowest, making up 7.07%. Regarding the learning modality, the study presented more respondents taking their online than offline, similar to the study of Singh et al. (2012), which showed more students taking online than offline learning. Thus, the stratified sampling method gave this study reasonable reliability in establishing instructional classroom policies. The researchers determined the probability that the chosen sample represented the larger population from which the former was obtained and had total control over the subgroups, ensuring that all of them were included in the sampling.

Level of AI-PCA Usage of Mathematics-Major Students DuringMathematics Summative Assessments

As shown in Table 3, the indicators of AI-PCA usage—different math areas, activities, and student achievement motives—were presented along with their mean, standard deviation, and description. It also presented their overall mean, standard deviation, and description. For the researchers to address the question regarding the AI-PCA usage of the mathematics-major students, they utilized the mean and standard deviation. The mean was used to determine the distribution's central location and a general idea of each indicator. Meanwhile, the standard deviation was used to determine how many individual responses to a question differ from the mean.

Table 3. Level of AI-PCA Usage of Mathematics-Major Students During Mathematics Summative Assessments

Indicator	*SD*	Mean	Description
Different Math Areas	0.66	2.68	High
Activities	0.72	2.42	High
Student Achievement Motives	0.67	2.11	High
Overall	0.59	2.40	High

The indicator different mathematics areas gained the highest mean score of 2.68 with a standard deviation of 0.66; this meant that the values generated from the responses were clustered around the mean. The result also suggested high AI-PCA usage in math summative assessments regarding the different mathematics areas. On the other hand, the student achievement motives gained the lowest mean score of 2.11 with a standard deviation of 0.67; despite having the lowest mean, the results from this indicator were still clustered around the mean. Like in the different math areas, the students demonstrated high AI-PCA usage in math summative assessments regarding the student achievement motives. Moreover, the remaining indicator—the activities—gained an overall mean of 2.42 with a standard deviation of 0.72; this indicator showed that the values generated from the responses were still clustered around the mean, and the students showed high AI-PCA usage in math summative assessments. The overall mean accumulated a 2.40 mean with a standard deviation of 0.59. In this case, the results from each indicator and their entirety demonstrated that they clustered around the mean due to having smaller standard deviations. The study gained data with less extreme values and accumulated reliable results. Hence, the inference that the mathematics-major students showed high AI-PCA usage in math summative assessments and academic dishonesty was reliable.

The data presented in Table 3 showed that the responses accumulated in each indicator were high, implying that the level of AI-PCA usage in mathematics summative assessments and academic dishonesty was high in distance learning. Among the three indicators, the different math areas had the highest mean value, indicating that students employed AI-PCAs the most in summative assessment across different math areas; this could be attributed to the reality that AIPCAs can effortlessly solve any math problem and provide solutions within a click. On the other hand, the indicator with the lowest mean but still had a high descriptive level was the student achievement motives; this suggested that students used AI-PCAs to achieve high grades. Overall, the students had a high AI-PCA usage in math summative assessments; they were constantly using AI-PCAs in distance learning and most likely spending less time on solving math problems manually since AI-PCAs are easily accessible and are quick to solve the math problems given by their teachers. In this case, the findings suggested that math professors must engage their students in interactive activities, such as math brain teasers or story problems, to exercise students' minds to lessen AI-PCA usage. Also, teachers should acknowledge that AI-PCAs could help shape the teaching-learning process in mathematics by allowing students to use AI-PCA during activities under supervision. Furthermore, implementing policies in the field would be beneficial in regulating students' AI-PCA usage and decreasing students' AI-PCA reliance and academic dishonesty.

The students used AI-PCAs across different mathematics areas, such as Statistics, Trigonometry, and Pre-Calculus, since these applications manifested intelligence (Peter, 2021; Posnick-Goodwin, 2020; Watkins, 2020; Williams, 2020); this paralleled the study results in which this appeared the highest among the indicators. Meanwhile, the student achievement motives yielded the lowest mean; however, in this indicator, the students still demonstrated high AI-PCA usage in math summative assessments and academic dishonesty. The said finding is consistent with Maeda's (2019) claim that academic dishonesty among students could stem from the frequent utilization of AI-PCAs. The students' motives might include attaining high grades, outperforming their peers, or avoiding poor performance in mathematics class. Overall, the high AI-PCA usage in math summative assessments and academic dishonesty could pose a significant threat to the future of mathematics and math practitioners because there is a possibility of reliance and not making sense of mathematical tasks and concepts (Agbo-Egwu et al., 2018). Still, using AI-PCAs in mathematics education could boost student achievement (Parrot & Leong, 2018), positing the importance of establishing policies to alleviate the issue. Teaching associated with AI-PCAs has the potential to enhance students' performance; facilitating interactive games prior to formal discussions might increase students' interest and engagement in math learning (Arrieta et al., 2021).

Test of Difference on the Level of AI-PCA Usage in Mathematics Summative Assessments According to Year Level

Table 4.1 shows the test of difference in AI-PCA usage in math summative assessments according to the respondents' year levels. The researchers analyzed the data using ANOVA to determine if the means of year levels differed. Also, the table described the mean and standard deviation (SD) of the three indicators—different math areas, activities, and student achievement motives—at each year level. The F-value, the result of the significance test (p-value) for each indicator, and whether to accept or reject the null hypothesis (H_o) could also be observed in the table below.

Table 4.1. Test of Difference on the Level of AI-PCA Usage in Mathematics Summative Assessments According to Year Level

Indicators	Year Level										F	Significance	Decision on H_o
	First Year		Second Year		Third Year		Fourth Year		Total				
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*			
Different Math Areas	2.58	0.71	2.23	0.34	2.89	0.43	2.75	0.51	2.68	0.65	1.717	0.177	Accept
Activities	2.25	0.48	2.03	0.86	2.56	0.57	2.63	0.71	2.42	0.72	1.474	0.234	Accept
Student Achievement Motives	2.33	0.58	1.55	0.60	2.31	0.70	2.06	0.62	2.11	0.67	2.095	0.114	Accept
Overall	**2.33**	**0.50**	**1.93**	**0.50**	**2.59**	**0.72**	**2.48**	**0.50**	**4.31**	**0.59**	**1.977**	**0.131**	**Accept**

As presented in Table 4.1, the overall result of the statistical tests showed that the mean and standard deviation of the level of AIPCA usage when analyzed based on the respondents' year levels were 4.31 and 0.59, respectively; this indicated that the data were clustered around the mean. Also, the overall result revealed no significant difference (F=1.977; p-value=0.131 at 0.5 alpha level) in the level of AI-PCA usage when analyzed according to the year levels of the respondents in terms of the following indicators: different math areas, activities, and student achievement motives. The first-year ($\bar{x}$ = 2.33; s = 0.50), second-year ($\bar{x}$ = 1.93; s = 0.50), third-year ($\bar{x}$ = 2.59; s = 0.72), and fourth-year ($\bar{x}$ = 2.48; s = 0.50) students were not significantly different from each other; this meant that regardless of their year level, all college respondents demonstrated high AI-PCA usage in math summative assessments and academic dishonesty in distance learning.

Based on the findings, there was high AI-PCA usage in math summative assessments and academic dishonesty among tertiary students when analyzed based on their year levels. As shown in the table, third-year students got the highest usage level among the other year levels. The third-year levels had more mathematics courses than other year levels, hence their reason for using AI-PCA to answer their summative assessments. Nonetheless, there was still no significant difference in the AI-PCA usage when analyzed based on the year level of 26 respondents; the data gathered supported the acceptance of the null hypothesis. The findings could be attributed to the fact that most first-year to fourth-year college students own a smartphone on which they could easily install AI-PCAs and use these applications to answer their math summative assessments, providing a sense of convenience because the answers and solutions are only a click away; this premise held across all year levels. Consequently, based on the results, it is necessary to formulate guidelines regarding AI-PCAs to regulate their usage and alleviate students' dependence on AI-PCAs to answer their summative assessments. Since the level of AI-PCA usage was the same based on the students' year levels, there would be a uniform policy for all year levels. Furthermore, teachers might design assessments limiting students' use of AI-PCAs to answer them. It is also crucial that teachers encourage academic integrity during the teaching-learning process and instill this principle in students so the latter understand the importance of exercising honesty.

According to Alfawareh and Jusoh (2014), most college students own a smartphone on which math applications can be easily downloaded, and these apps have advanced computing abilities to answer math problems. Consequently, college students, regardless of their year levels, projected academic dishonesty in distance learning, which has been ascertained to be of negative convenience to students taking math courses as it could lead to plagiarism when not used appropriately (Sloan-Lynch et al., 2022; Peter, 2021). The study results paralleled the findings of Khan and Balasubramanian (2012); they found no significant difference in e-cheating when respondents were grouped according to their year level. In this case, it was evident how college students could cheat their way into distance learning and demonstrate academic dishonesty. It is also essential to note what Mead (2014) stressed, that many first-year college students were vulnerable to committing errors in basic mathematical procedures; if this persisted, students would likely find it difficult to develop a solid mathematical foundation that would lead them to have problems dealing with high-level mathematics later on and depend on AI-PCAs. The highlighted statement by Mead reflected on the study results, more so that the third-year and fourth-year respondents ranked first and second to demonstrate high AIPCA usage in math summative assessments and academic dishonesty in distance learning. Furthermore, since there was no significant difference in the level of AI-PCA usage based on the year levels, teachers were encouraged to construct summative assessments across all years levels in a way that students could not resort to AI-PCAs for solutions and answers (Seeland et al., 2021). Math teachers could create an assessment emphasizing synthesis and self-reflection for students to understand the significance of their skills and knowledge as practitioners in their field (Seeland et al., 2021); this could be accomplished by conducting genuine assessments that mimic real-world tasks because authentic assessments could add the benefit of being more difficult to cheat using AI-PCAs). In this case, teachers can still foster a learning environment that promotes honesty and academic integrity despite not ascertaining that students would not attempt to cheat (Piascik& Brazeau, 2010).

Test of Difference on the Level of AI-PCA Usage in Mathematics Summative Assessments According to Learning Modality

Table 4.2 showed whether there was a significant difference in AI-PCA usage when analyzed by the respondents' learning modality, online and offline learning; the study analyzed the data using ANOVA. The table also presented the mean, standard deviation, F-value, and p-value of the three indicators: different math areas, activities, and student achievement motives. The F-value determined the test's statistical significance; the p-value showed how probable the study would have found a specific collection of observations if the (H_o) were true.

Table 4.2. Test of Difference on the Level of AI-PCA Usage in Mathematics Summative Assessments According to Learning Modality

Indicators	Learning Modality						F	Signifi-cance	Decision on H_o
	Online		Offline		Total				
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*			
Different Math Areas	2.67	0.61	2.68	0.77	2.68	0.66	0.001	0.978	Accept
Activities	2.51	0.72	2.20	0.70	2.42	0.72	1.965	0.167	Accept
Student Achievement Motives	2.09	0.67	2.16	0.69	2.11	0.67	0.111	0.740	Accept
Overall	**2.42**	**0.58**	**2.34**	**0.50**	**2.40**	**0.59**	**0.171**	**0.681**	**Accept**

As shown in the table above, there was no significant difference (F = 0.171; p-value = 0.681 at 0.5 alpha level) in the level of AI-PCA usage when analyzed according to the modality of the respondents. The overall mean value was 2.40 and a standard deviation of 0.59; this indicated that the data points were grouped around the mean. The findings showed that the online ($\bar{x}$ = 2.42; s = 0.58) and offline learning ($\bar{x}$ = 2.34; s = 0.50) modes of the math-major students were not significantly different from one another; this indicated that AI-PCA use was high, regardless of the learners' learning modes.

In terms of indicators, such as different math areas, activities, and student achievement motives, Table 4.2 indicated no significant difference in the respondents' level of AI-PCA use when assessed according to modality. All college math majors used AI-PCAs to answer their math summative assessments, and the table showed that their level of AI-PCA usage in math summative and academic dishonesty was high. Math-major students indicated high AI-PCA usage regardless of their modality since they could access the application easily, whether they were online or offline learners. The findings suggested that students believed the applications would assist them in their difficulties while answering their math summative assessments, although their actions displayed academic dishonesty. Additionally, given that there was no significant difference in modality between online and offline learners, the researchers would formulate one policy—stating the guidelines and roles and responsibilities of the parties involved—uniform to both modalities to control student reliance in using AI-PCA. As a result, establishing policies and guidelines to regulate AI-PCA usage among online and offline learners would be simplified. The math teachers would be encouraged to address the problem by utilizing the policy applicable to online and offline students.

According to Wolverton (2016), about a third of all college students, or seven million students, were enrolled in at least one online course last year, equivalent to tens of thousands of online cheaters yearly. There was a widespread perception that cheating would be easier and more widespread in online courses, especially when students encounter difficulties in math-related courses. While Turner and Uludag (2013) stated that cheating in online and offline exams was not significantly different, students who were proficient in the use of technology would find ways to cheat to finish their homework in the distance learning with little effort and in ways that are difficult to detect (Young, 2016); this implied that online and offline students were frequently unmonitored and could have the freedom to share answers to tests completed at home or in any location with Internet access. Since the students were in distance learning, they resorted to using AI-PCAs and manifesting academic dishonesty due to the low possibility of being found or receiving little or no punishment if caught. According to Burrus et al. (2011), the policy would be enforced more consistently if faculty members presented a common definition of academic dishonesty. After developing a common definition, the instructor must explain this term to the students. This collaborative effort might help reduce the amount of academic dishonesty and the worry of students who previously did not comprehend what academic dishonesty entailed (Owunwanne et al., 2010).

Instructional Classroom Policies

The research questions that the study sought to answer, such as the demographic profile of the respondents taking BSEdmajor in Mathematics in a tertiary Catholic institution, their level of AI-PCA usage in math summative assessments, and the test difference in their level of AI-PCA usage when grouped according to their year level and learning modality, were addressed through survey and statistical analyses. Subsequently, out of 50 respondents, the study found high AI-PCA usage in math summative assessment and no significant difference concerning the preceding matter when the responses were grouped according to the respondents' year level and learning modality. In this case, there would be one uniform policy for the mathematics-major students, no matter their year level or learning modality. This section presented the framework of the policy formulated based on the study results concerning the AI-PCA usage of the students in math summative assessments.

Policies and Guidelines on the Artificial Intelligence-Powered Calculator Application Usage in an Instructional Classroom

Rationale

Based on the recently conducted study by the researchers, there is a high level of usage of artificial intelligence-powered calculator applications (AI-PCAs) in math summative assessments among BSED-Math students. As a result, this policy establishes a framework for developing and implementing academic guidelines governing AI-PCA utilization by mathematics-major students during math summative assessments and class instruction. One of the main reasons the researchers want to develop policies regarding AI-PCA is that using mathematical applications leads to academic dishonesty, especially when students rely solely on these apps for answers.

Moreover, establishing policies inside the classroom enables the mathematics subject area coordinator, math teachers, and students to create a safe, effective, and conducive environment for learning. Also, a clear and well-written set of policies regarding the usage of AI-PCA assists students in regulating their use of these math applications so that they can only use them to enhance their learning experience and hone their mathematical abilities to their full potential. This policy provides guidance and accountability and sets expectations and limitations on how students can and may use AI-PCAs in classroom instruction and during math summative assessments.

The shift to distance learning due to the threat of COVID-19 has led students to be dependent on math apps for solutions and answers to their math summative assessments. According to several studies, students who repeatedly plagiarize math solutions solved by an AI-PCA may lose their ability to think critically. If this is not regulated, the academic damage it will cause might be irreversible. Consequently, it is vital to develop feasible policies to protect students from the negative effects of becoming reliant on mathematical applications. Hence, the researchers aim to propose research-based policies for regulating AI-PCA usage.

As members of a Catholic Institution, students must uphold integrity. Holden et al. (2021), stated that academic integrity means adhering to the ideals of honesty, fairness, and responsibility, which any Catholic institution shall promote. Moreover, policies promote integrity; thus, we shall formulate effective policies to regulate AI-PCA usage during math summative assessments. These policies will ensure mathematically competitive graduates in the future.

Objectives

This policy, with an efficient advisory framework, aims to:

1) create a learning environment that stimulates responsibility and accountability in regard to the usage of AI-PCA during classroom instruction and math summative assessments;
2) assist students in using AI-PCA responsibly to enhance their mathematical ability while appropriately avoiding abuse and over-reliance on AI-PCA and lessening academic dishonesty;
3) assist students in recognizing academic integrity and developing a mature mentality;
4) assist students who are experiencing academic difficulties that are affecting their academic achievement;
5) assist students in preventing the harmful consequences of over-reliance on AI-PCA;
6) help teachers feel less concerned about students using AI-PCA for academic dishonesty.

Guidelines

1) The Mathematics subject area coordinator and the math teachers shall accept and integrate the use of smartphone applications for relevant problems.
2) At the start of the semester, the Mathematics subject area coordinator and the president of the mathematics society shall work hand in hand to conduct a meeting and discuss the policies and guidelines concerning AI-PCA usage in an instructional classroom and during math summative assessments.
3) Upon admission and through each semester, the Mathematics subject area coordinator of the mathematics society, math teachers, and students will adhere to the policies and guidelines concerning AI-PCA usage.
4) The Mathematics subject area coordinator and the math teachers shall allow students to use AI-PCAs in synchronous classes and math summative assessments in the following math content areas only: College and Advanced Algebra, Trigonometry, Pre-Calculus, Basic and advanced Calculus, Plane and Solid Geometry, Modern Geometry, Elementary Statistics and Probability, and Advanced Statistics.
5) The Mathematics subject area coordinator and the math teachers shall allow students to use AI-PCAs in math summative assessments, provided that the latter showcase profound mathematical abilities during the synchronous classes and formative assessments. The math teacher shall announce the list of students who can use AI-PCAs in math summative assessments before the examination day.
6) All online and offline students shall take the math summative assessments on the scheduled date and time. If they cannot take the examination on time, the students must inform their teachers ahead of time for the latter to reschedule a uniform date and

time for all the late exam takers. Failure to inform the teachers will lead to a zero (0) score on the examination.

7) The math teachers will submit reports at the end of each academic year regarding the effectiveness of this policy and student progress, which will strengthen the policies and guidelines.
8) The reports that will be stored in Google Drive other soft or hard copies are kept private and must comply with the Data Privacy Act.

Roles and Responsibilities of Mathematics Subject Area Coordinator

The Mathematics subject area coordinator is the liaison officer of every student who majors in Mathematics and their respective administration. They will provide strategic planning within the department and facilitate the resources for the program development by implementing and assisting in carrying out all the department's objectives, programs, and activities. With this, the task of the Mathematics subject area coordinator is to supervise the teachers and mathematics-major students in using AI-PCAs in classroom instruction and during math summative assessments. As a result, the Mathematics subject area coordinator will:

1) implement policies concerning AI-PCA usage in summative assessments to lessen academic dishonesty inside an offline and online Mathematics classroom;
2) develop instructional websites that incorporate principles of active learning that can lessen the possibility of academic dishonesty;
3) integrate the usage of AI-PCAs into the contents of the course syllabus by identifying when it is necessary to use them;
4) synthesize programs that allow students to be trained in AI-PCA use with an explanation of their positive and negative effects, especially in research;
5) administer syllabus-oriented methodologies that integrate AI-PCA use in the best way possible;
6) conduct educational discussions for math teachers and students on the pros and cons of AI-PCAs;
7) allow the use of proctoring software, such as live proctoring, record-and-review proctoring, and auto-proctoring, wherein it has the ability to monitor everything that students are doing during online assessments (Kanchan, 2021);
8) assist teachers in relating their duties on how to manage and inform students regarding the use of AI-PCAs during summative assessments;
9) encourage teachers to let the students know their potential in enhancing their mathematical learning and abilities with and without using AI-PCAs.

With the roles and responsibilities of a Mathematics subject area coordinator being laid out for AI-PCAs, the workflow encourages the use of AI-PCAs based on their positive effects and discourages them based on their negatives. Essentially, the Mathematics subject area coordinator shall orient on when best to use these applications for the aid of students, integrate their use into the syllabus properly, and establish policies regarding their use to beat academic dishonesty involving AI-PCAs.

- Roles and Responsibilities of Mathematics Teachers

Mathematics teachers are responsible for developing students' theoretical and mathematical skills. The task of math teachers is to facilitate student learning and give assessments to test students' knowledge and comprehension of the lessons. Subsequently, a high level of AI-PCA usage is found among mathematics-major students while answering their math summative assessments during distance learning. Given the findings concerning AI-PCAs, math teachers will have additional roles and responsibilities to beat the abusive usage of AI-PCAs and help lessen the academic dishonesty involving these applications in distance learning.

As part of the Mathematics department, the teachers have the roles and responsibilities to:

1) attend educational discussions on the pros and cons of AI-PCAs;
2) attend seminars or pieces of training on Internet literacy;
3) facilitate students when they attend pieces of training on AI-PCA usage;
4) monitor students who showcase profound mathematical skills and knowledge during synchronous classes and formative assessments;
5) reschedule a uniform date and time for all students who cannot take the math summative assessments on the scheduled date assigned by the institution.

As facilitators of learning in an instructional classroom, the teachers have the roles and responsibilities to:

1) discuss the lessons in a simple manner and provide some techniques for answering math problems in order to reduce the need for AI-PCA;
2) teach students how to perceive and understand mathematical ideas;
3) facilitate the students in answering math problems to enhance their skills and knowledge in mathematics by:
a. letting the students answer on their own,
b. only guiding them if they do not know how to solve the equation, and
c. answering queries through the use of the Socratic method and not spoon-feeding;
4) assist those students who experienced difficulties in answering math problems;
5) encourage students not to depend solely on AI-PCA as their primary source of answers (Photomath, 2019) by:
a. providing an easy step-by-step method,
b. delivering encouraging words regarding mathematical problems,
c. explaining to them that AI-PCAs are not always the answer to all mathematical problems, and
d. reminding them that AI-PCAs will be used for solution comparison and verification, not for answering questions;
6) conduct regular interactions with students via online learning, such as giving math problems and allowing students to answer on their own with open cameras so that the teacher knows who is answering the question (Baker Bemmel, 2014);
7) playing mathematical games presented by the teacher via oral and face-to-face/open camera engagement;
8) inform students about the pros and cons of relying on AI-PCAs;
9) conduct an activity that will let the students know about their responsibility in learning on their own and have confidence in their math learning capabilities;
10) allow students to comprehend the mathematics that underlies AI-PCAs and to develop into proficient users with self-discipline and the capacity to assess the feasibility of responses mentally (Photomath, 2019);
11) provide visual presentation so that students will develop their intuition in learning a new concept (Photomath, 2019);
12) make connection between topics by unifying themes.

As proctors during the taking of math summative assessments, the teachers have the roles and responsibilities to:

1) secure online and offline exams;
2) take advantage of the extensions and features in Google forms or other softwares;
3) use multiple versions of exams like implementing sets A, B, and C to reduce cheating and dishonesty (Baker Bemmel, 2014);
4) establish cheating traps by generating websites containing test questions and wrong answers, causing students to become confused and solve the math problems independently (Baker Bemmel, 2014);
5) present items one at a time rather than all at once to prevent students from sharing them in their respective group chats(Cluskey et al., 2011);
6) formulate un-AI-PCA-ble questions for the students by:
a. designing questions that help support their mathematical literacy and acquisition of general math knowledge,
b. asking simple conceptual questions to motivate critical thinking,
c. designing challenging questions that will show off mastery and application of understanding,
d. letting them create their activities and mathematical questions,
e. asking them to explain their answer if they truly understand and to ensure that they are the ones solving the problem,
f. providing various questions in a worded problem,
g. using stories as mathematical problems that need resolution,
h. posing simple mathematical, and conceptual problems and addressing concerns of application, and
i. writing procedural problems in the existence of smartphone apps (Ozkan et al., 2021)
i. write questions in words and let students rewrite them in mathematical notation;
ii. ask students to solve a problem in a specific order of steps;

iii. use symbols instead of variables in equations or functions;
iv. ask reverse questions;
v. provide the answer to the question and ask for detailed explanations in words.

7) monitor the AI-PCA usage of students in math summative assessments (McGee, 2013) by:

a. checking the start and submission times to track how long the student takes the assessment;
b. requiring the students to have two gadgets—one for the camera at the back and the other for taking the summative assessment;
c. comparing the solutions submitted by the students to the one presented in the AI-PCAs.

Roles and Responsibilities of Students

The students are responsible for their academic progress and behavior in the mathematics class. It is essential that they actively engage in the activities happening inside the classroom, such as answering all the assessments and tasks assigned by the teacher by limiting the use of AI-PCAs.

As students, during classroom instruction, they have the roles and responsibilities to:

1) prepare their minds to learn a new lesson and reduce the thought of relying on AI-PCA;
2) take notes and listen carefully, especially when the teacher is providing techniques and shortcuts to a given solution;
3) practice solving equations in their spare time or at home to improve their mathematical skills, which will reduce their need for AI-PCA;
4) understand the lesson thoroughly and create their own techniques to test their capabilities in answering math problems;
5) ask clarification to the teacher when the lesson is not clear and understandable rather than depending on AI-PCA;
6) check the steps of the solution offered by AI-PCAs and constantly interpret the suggested answer (Kelecsényi et al. 2021);
7) question the results since reports are saying how AI-PCAs show incorrect answers sometimes (Kelecsényi et al. 2021);
8) constantly verify the steps of the new ideas arising and recalculate the results accordingly (Kelecsényi et al. 2021).

As students, during the time they take their math summative assessments, they have the roles and responsibilities to:

1) prepare two gadgets,one for the camera at the back and the other for taking the summative assessment;
2) take the math summative assessments on the scheduled date and time;
3) inform their teachers ahead of time if they cannot take the examination at the scheduled date and time;
4) answer the questions using the techniques provided by the teacher;
5) make every effort to limit their reliance on AI-PCA as their primary source of information to avoid cheating and dishonesty;
6) keep in mind that AI-PCA is only a guide, not a method for resolving mathematical problems (Photomath, 2019);
7) assess their knowledge by using AI-PCA to see if their responses are correct.

CONCLUSION AND RECOMMENDATIONS

The study aimed to determine the level of AI-PCA usage in mathematics summative assessment to craft instructional classroom policies. The researchers used a quantitative research design, particularly the descriptive-comparative design, to address the study's aims and problems. The respondents were BSEd students who majored in Mathematics in the 2nd semester of the academic year 2021-2022 in a tertiary Catholic institution. A modified survey questionnaire tailored from multiple related questionnaires was crafted to encapsulate the needs of the study. The researchers also utilized statistical tools like frequency, percentage, mean, standard deviation, and ANOVA to describe, summarize, and make inferences about the collected data. Based on the study's collected data, these findings could be inferred: (1) Among the 50 respondents chosen, the study obtained the highest feedback from the 16 first-year students, with 32 percent of the total sample size, followed by 15 third-years with 30 percent and 13 fourth-years with 26 percent. The least represented stratum of respondents belonged to the six second-years with 12 percent. Among the respondents, 35 students, or 70 percent, took online classes, while 15 students, or 30 percent, opted for offline learning modality. (2) The AI-PCA usage level was high in mathematical summative assessments and academic dishonesty. (3) There was no significant difference between the study's findings when analyzed according to the year level and learning modality. (4) The policies to be implemented by the authorities would be shared among the mathematics subject area coordinator, mathematics teachers, and students.

Conclusion

Based on the study results, it could be drawn out that most of the study's respondents were first-year students, and the second-year students comprised the minority. As for their learning modalities, there were more respondents taking online than offline learning modalities.

Then, in the findings in which the students demonstrated a high level of AI-PCA usage in math summative assessments and academic dishonesty, it could be drawn out that the mathematics-major students relied on AI-PCAs in distance learning since these applications manifested intelligence and qualities or features advantageous to users. Neither the teachers nor other school authorities could determine who among the students was upholding academic integrity while taking the math summative assessments. Also, these findings implied that the results of the math summative assessments of these students in distance learning were not valid, credible, and reliable.

The said implications were true for all year levels and learning modalities. There was no significant difference in the level of AI-PCA usage in math summative assessments and academic dishonesty when the respondents were grouped according to their profile; regardless of the student's year level or learning modality, they would still demonstrate such usage of AI-PCAs. The reality that the students were in distance learning and could easily access or download AI-PCAs while coping with the difficulties of their math courses must have led them to have high AI-PCA usage while taking their math summative assessments.

While the said results and implications were today's reality in the institution where the study was conducted, it was still possible to mitigate its future impacts with responsibilities shared between the authorities and all other parties involved in the issue at hand. The study contained formulated policies and guidelines uniform to all year levels, no matter their learning modality, which would benefit the CHED, school administrators, mathematics area, teachers, students, and future researchers. In this case, it was still possible for students to use AI-PCAs in math summative assessments without overlooking the importance of learning mathematical concepts and applications.

Recommendations

High AI-PCA usage and academic dishonesty in distance learning were found based on statistical analysis and literature review. There was also no significant difference in the results when the respondents were grouped according to their year level and learning modality. The results of this study would highly recommend the following:

The Commission on Higher Education (CHED) is called to conduct methodology seminars regarding AI-PCA use for stakeholders, especially faculty heads and administrators. Their collegiate-level power would allow stakeholders to be oriented about AI-PCAs and their role at the institutional level. The study would also like the CHED to acknowledge the importance of incorporating AI-PCAs in instructional classrooms and math summative assessments, especially since teachers cannot win against these applications due to their accessibility. Instead of completely abolishing AI-PCAs, the CHED might use the opportunity to encourage math teachers to progress and find ways to beat the abusive usage of the students of AI-PCAs.

For school administrators, policies are encouraged to be implemented to control the usage of AI-PCAs at an institutional level, trickling down from the administrators, chairs, and instructors so that rules and regulations might be implemented well. They are also encouraged to perform surveys to determine appropriate subjects and criteria, wherein various math apps can be incorporated and evaluated. Also, they are called to upgrade the Google Workspace or any software they use for convenient monitoring of the AI-PCA usage of the students while taking math summative assessments; this can help minimize cheating in online summative assessments.

With the mathematics area being in the scope of the study, it is crucial that they implement orientations regarding AI-PCA usage, balancing the positives and the negatives. They are called to monitor and modify the formulated policy when deemed necessary. Moreover, since these applications are accessible to the students, the mathematics area is encouraged to upgrade the teaching-learning inside the classroom and reassess how they construct and conduct their math summative assessments.

This study encourages instructors to advance how they facilitate their classes by incorporating AI-PCAs in synchronous classes. It is also crucial for instructors to carefully plan how they design or construct the math summative assessments before administering them. Moreover, the study suggests that they familiarize themselves with the qualities or features of AI-PCAs—from the most to least accessible—to combat academic dishonesty and carefully compare the solutions presented. Since it is difficult to differentiate who among the students exercises academic integrity while taking math summative assessments, the instructors are called to constantly check the solutions submitted by their students and ask them about the submitted solutions as part of their recitation to ensure that these answers are not entirely from AI-PCAs and that the students know the process. The instructors are also advised to impose rules and regulations regarding AI-PCA use and the need for institutional permission if they have the liberty to do so. This study could provide valuable data on classroom-level mechanisms of AI-PCA use so that instructors might use it as a guide in formulating policies. The study encourages instructors to take advantage of the formulated policies and guidelines regarding AI-PCA usage in relation to math summative assessments.

The students are called to take responsibility for choosing Mathematics as their major. They are encouraged to study and learn the required mathematical knowledge and skills that will help them once they enter the teaching field. They might use math-related applications to support their independent learning during the learning process of this type of classroom instruction; still, they were advised to adhere to the guidelines and policies in using this AI-PCA. In this case, students might acquire the expected knowledge, skills, and values even when they learn independently. Thus, they were called to take responsibility and accountability for their actions in using math-related applications, as academic dishonesty causes numerous issues within the educational context.

Future researchers are provided with comprehensive quantitative data regarding academic dishonesty at an institutional level, focusing on AI-PCA misuse. Evaluation and action research might subsequently be done accordingly on future researchers' chosen institutions with the help of data from this study. Moreover, they are encouraged to research some areas that the researchers could not cover, such as the impacts of using AI-PCAs in their mathematical thinking. Also, since this study only has a small number of respondents due to the population of BSEd Mathematics students, other researchers might conduct research with more respondents when they have a large population. Future researchers might also use the qualitative research design to delve deeper into AI-PCAs. They might also consider determining the effects of the regulation of AI-PCA usage in math assessments and during instructional classrooms based on the framework provided by the present study. Furthermore, a tracer study may be conducted in the future; it may focus on the correlation between the BSEd Mathematics students using AI-PCAs during the pandemic and their rating during the licensure examination for teachers (LET) or whether they passed the LET.

Overall, the data in this study could help the CHED, school administrators, mathematics areas, teachers, and students in curbing academic dishonesty at a classroom level, an institutional level, and, above all, a wide-reach academic systemic level.

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