

# Extent of Mathematics Teachers' Utilization of Generative Artificial Intelligence Across Key Pedagogical Dimensions

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## ABSTRACT

This study was conducted in view of the current state of utilization of Generative Artificial Intelligence by teachers and students alike. Specifically, it sought to investigate the extent to which Mathematics teachers in private schools in Manila use Generative AI as a tool to help them in the preparation, instruction and evaluation dimensions of teaching. Analyses of significant differences in extent of generative AI utilization when the 83 teacher participants were grouped according to sex, age generation (X, Y and Z), educational attainment, and amount of AI training received were conducted. Using a non-experimental, cross-sectional, quantitative descriptive -

comparative research design, findings included that there is a relatively balanced use of Generative AI as a tool for the pedagogic dimensions of preparation, instruction and evaluation. When results were analyzed for correlation between extent of utilization and group characteristics, it showed that there is no significant difference in the use of generative AI between male and female, between age generation and educational attainment. The only significant finding is on the amount of Generative AI training received especially between those that reported having received only “basic” training and those that received “extensive training where the p-value is <0.001 These results highlighted the need to provide teachers with a research-based structured Generative AI training for using it as a tool for teaching Mathematics in the three specified pedagogic domains. The researcher proposed, based on the findings, a three-tiered “dose-response” training program where training load (dose) will align with the expected performance change (response). The action plan aims at providing Mathematics teachers the opportunity to universally receive basic training on the use of generative AI while at the same time providing a pathway that will enable them to become experts, and then later, mentors or coaches on the utilization of generative AI as aid for teaching.

**Keywords:** *GenAI, Mathematics, preparation, instruction, assessment, Dose-response, action plan*

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## INTRODUCTION

The recent rise in the use of Generative Artificial Intelligence (AI) tools such as ChatGPT, Gemini, and Microsoft Copilot among both teachers and students has changed the conduct of teaching and learning. For teachers, generative AI or AI in general offers new opportunities for them to enhance instruction and assessment. It also impacted how they engage in professional development including engagement in continuing education. Although still cautious, teachers report using AI, even experimenting with them. Teachers reported experimenting with AI tools like ChatGPT to help with tasks such as generating lesson materials or explanations, but most are still unsure about best practices, long-term effects, and how much trust to place in generative AI outputs (Guo et al., 2025; Picton & Clark, 2025; Đerić et al., 2025).

While keeping the emphasis on human judgement, recent studies have shown that AI is increasingly used by teachers to support lesson planning, assist in the implementation of differentiated instruction, and construction of appropriate assessment activities. Currently, many free and for paid subscription platforms help teachers with tasks such as writing, communication, image creation, and even classroom management. These tools can act as a kind of “personal assistants” to teachers, reducing time and effort spent on routine tasks allowing teachers to focus on more meaningful interactions with students.

In the Philippines, the use of Generative AI for teaching and learning presents both opportunities and challenges. Filipino teachers, especially the younger ones, have a good grasp of the use of AI and are open to admitting to using them to help them prepare lesson plans, assessment and instructional materials. However, these teachers would also admit to needing more training on pedagogic and technological skills, and more information on how to ethically use AI for teaching. Guo et al. (2025), Picton & Clark (2025), and Đerić et al. (2025) reported that teachers shared that generative AI could help lighten planning workloads or act as a brainstorming partner especially for generating examples, explanations, or differentiated materials more quickly.

In Mathematics education, AI has the potential to become not only a valuable resource for improving the teaching and learning of Mathematics, but also as an indispensable tool for changing perspective on a subject often viewed as abstract and challenging.

Against this backdrop, this study was undertaken to investigate the Mathematics teachers' extent of utilization of Generative Artificial Intelligence across the three key pedagogical dimensions of preparation, instruction and evaluation. Specifically, it aimed to answer the following questions: 1. What is the profile of Mathematics Teachers in terms of - a. sex, b. age generation, c. educational attainment, and d. Artificial Intelligence training received? 2. What is the extent of utilization of Generative Artificial Intelligence of Mathematics teachers in the pedagogic domains of - a. preparation, b. instruction, and c. evaluation? 3. Is there a significant difference in the extent of Generative Artificial Intelligence utilization of Mathematics teachers in the pedagogic domains of preparation, instruction and evaluation when grouped according to a. sex, b. age generation, c. educational attainment, d. artificial intelligence training received? 4. What action plan for faculty development of Mathematics teachers in relation to Generative Artificial Intelligence use may be proposed based on the findings?

The null hypotheses were tested at the 0.05 level of significance:  $H_0$ : There is no significant difference between the extent of Mathematics Teachers' utilization of generative AI in the pedagogic domains of preparation, instruction and evaluation when grouped according to sex, age generation, educational attainment, and Artificial Intelligence training received.

## **METHODS**

### **Research Design**

This research study employed a non-experimental, cross-sectional, quantitative descriptive - comparative research design. This design allowed the researcher to capture a snapshot of current practices among Mathematics teachers at a single point in time, without manipulating variables. Specifically, it was used to determine the extent of teachers' utilization of generative artificial intelligence across key pedagogical domains and to examine whether differences exist when grouped according to sex, age generation, educational attainment, and level of AI training received. The numerical data provided objective measurement, identify patterns and differences in generative AI utilization in a systematic way. By using descriptive and comparative elements together, the study produced results that are empirically grounded and practically relevant for educational decision-making. The design ensured that results could inform training programs and future research directions, making it both academically rigorous and socially meaningful.

### **Research Locale**

The study was conducted in private Junior High Schools in Manila. Private schools in Manila offer a particularly relevant context for this investigation as they are recognized for their relatively stronger access to technological resources, which makes them ideal for exploring how teachers utilize generative AI in pedagogy. Moreover, these schools enjoy greater autonomy in adopting innovations, allowing them to integrate emerging technologies such as AI-based tools more flexibly into teaching and learning. The diversity of Mathematics teachers in private schools in terms of educational attainment, AI training received, and teaching experience provided a rich basis for examining differences in generative AI utilization across groups.

Conducting the study in Manila facilitated both accessibility and efficiency in data collection. The geographic concentration of schools allowed the researcher to administer surveys and follow up with participants in a timely and organized manner. This focus ensured that the results would be practical, contextually relevant, and actionable for understanding AI integration in Mathematics instruction within private school settings.

### **Sampling Technique**

The participants of the study were Mathematics teachers currently teaching in private Junior High Schools in Manila. A purposive sampling technique was employed in the study. The total sample size was

83 teachers, determined using a sample size calculator for one-way analysis of variance (ANOVA). The calculation was based on a statistical power of 0.5, with three groups, a medium effect size of 0.25, and a significance level of 0.05. An addition of 20% to this number to serve as intermediary for possible invalidated questionnaires later yields to 100.

Data for this study were collected from the sample using a researcher – developed questionnaire designed to measure the extent of Mathematics teachers' utilization of generative AI across three pedagogical domains such as preparation, instruction and evaluation. The instrument consisted of two main parts: first, the profile of the respondents that includes sex, age generation, educational attainment, and level of AI trainings. Second, the extent of generative AI utilization which assessed teachers' use of AI in the three pedagogical domains. The questionnaire consisted of 21 items, with seven items per domain. The first domain is the preparation which measured how the teachers utilized generative AI in lesson planning, resource gathering, and instructional material design. The domain instruction dealt with the teachers' use of generative AI in delivering lessons, facilitating classroom activities, and engaging students in learning. Lastly, evaluation assessed teachers' application of generative AI for student assessment, feedback, and performance monitoring.

Responses were recorded on a 5 – point Likert scale, ranging from 1 (Very Low Extent) to 5 (Very High Extent), which allowed for quantitative measurement of the degree of generative AI utilization across the pedagogical domains.

## **RESULTS AND DISCUSSION**

### **Respondents' Profile**

The respondents in this research are 62.65% female and only 37.35% male. This is a distribution that is consistent with the characteristic of Philippine education workforce which is dominated by female. As for Age Generation, majority of the respondents are Gen Zs at 48.19% followed closely by respondents who belong to Gen Y at 42.1% and a handful of Gen Xers at 9.64%. This means that the respondents are mostly young and can be considered as digital natives who were born in the age of the Internet and have access to very advanced technologies from early on in their lives. Most of the respondents, 89.16%, reported a bachelor's degree as their highest educational attainment and only a handful of them have a master's degree. Though included in the options, no one reported to have a doctoral degree. In terms of training on generative AI received, 62.65% reported having received less than 10 hours of formal and/or informal training, 19.28% reported having moderate training of between 10 to 20 hours and only 18.07% reported having extensive or more than 20 hours of training.

### **Extent of Generative AI Utilization Across the Three Pedagogic Dimensions of Preparation, Instruction and Assessment**

Overall, the respondents registered a high level of generative AI utilization at 3.55. This level is characterized by teachers frequently using generative artificial intelligence to assist them in various

teaching tasks such as planning, content development, and evaluation, although its application may not yet be fully integrated across all instructional activities. Of the three pedagogic dimensions, it is in instruction that the respondents reported using generative AI the highest at 3.62 followed by preparation at 3.56 and evaluation at 3.46. A casual interpretation of this is that the respondents use generative AI to help them in all dimensions of teaching at relatively the same extent. Female showed moderate utilization while male showed high utilization. Gen X and Gen Y showed Moderate utilization compared to the high utilization of Gen Z. Bachelor's holder group reported a moderate utilization while master's degree group reported high utilization. Meanwhile, those who reported having received extensive training on generative AI reported high utilization and interestingly, those who reported basic training and moderating showed only moderate utilization.

### **Difference in Extent of Generative AI Utilization When Grouped According to Profile**

The results of the study indicate that there is no significant difference in the extent of generative AI utilization when respondents are grouped according to sex, age generation, or educational attainment. Specifically, male and female respondents show similar levels of usage, and bachelor's degree holders and master's degree holders also do not differ significantly. Likewise, across generational cohorts such as Gen X, Gen Y, and Gen Z, no significant differences were observed. However, training in generative AI emerges as the most influential factor. Between those with basic training and those with moderate training, there is no significant difference, but a significant difference is evident between moderate and extensive training. Most notably, a very large and practically meaningful difference exists between respondents with only basic training and those with extensive training, underscoring the critical role of comprehensive training in driving higher levels of generative AI utilization. These findings highlight that demographic variables exert little influence, while training intensity strongly shaped actual adoption and use.

### **Dose-Response Professional AI Training Horizon**

The results of the study showed that there is only a statistically significant difference among the groups on generative AI utilization when grouped according to the Generative AI training received thus an action plan for faculty development that is based on the concept of Dose-Response Relationship was developed. A dose-response relationship is one in which increasing levels of exposure are associated with either an increasing or a decreasing risk of the outcome (Pettygrove, 2025). It can be seen from the results that more extensive training is associated with meaningfully greater generative AI use in practice. The three-tiered program will give Mathematics teachers the opportunity to universally receive basic training on the use of generative AI while at the same time providing a pathway that will enable them to become experts, and then subsequently, mentors or training coaches on the utilization of Generative AI for teaching Mathematics.

The Dose-Response Professional AI Training Horizon (DR PATH) on Generative AI Utilization for Teaching is a direct offshoot of what this study yielded as results, specifically that there is a clear and systematic relationship between the amount of generative AI training Mathematics teachers received and the extent of their AI utilization across the pedagogic dimensions of preparation, instruction, and evaluation.

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## CONCLUSION

There is overall high generative AI adoption among Mathematics teachers. Utilization, although uneven, is relatively balanced for the pedagogic dimensions of preparation, instruction and evaluation signifying the flexibility and variety of available Generative AI tools. There is no gender effect, a confirmation of evidence from other similar research. Surprisingly, age generation and academic credentials also demonstrate no significant effect. However, Generative AI training intensity matters as seen in the gap between basic and moderate (Moderate utilization) and extensive (High utilization). This result shows a clear dose–response pattern. Short training on generative AI may raise awareness but more intensive training is required to effectively change teachers’ pedagogic behavior and decisions.

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