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Design and Evaluation of a Technology-Enhanced Professional Development Program for Secondary Mathematics Teachers

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Abstract. This study aimed to develop, implement, and evaluate a professional development (PD) program for secondary mathematics teachers that was focused on using technology-enhanced resources, following Desimone's PD model. The program, consisting of eight in-person training sessions and virtual consultations over 10 weeks, involved Junior and Senior High School Mathematics teachers from a cooperative school. A mixed-method sequential explanatory research design was used, beginning with a training needs assessment of 15 teachers. There were also 15 teachers in the actual PD program. The results highlighted the lack of technology integration and PD opportunities as key challenges. Based on Desimone's model, the PD program addressed these needs by training teachers in digital calculators, Microsoft Excel, and statistical software. Pre- and post-assessments showed improvements in teachers' knowledge, skills, and attitudes in using technology-enhanced resources. Interviews confirmed these gains, and participants expressed interest in future training on integrating statistical software for research purposes, indicating a desire for ongoing PD.

Keywords: Desimone's model; mathematics teacher; professional development; technology-enhanced resources; teacher training

1. Introduction

Amidst the rapid advances in information and communication technology (ICT), integrating technology-enhanced resources (TERs) has become pivotal in modernizing education. Moreover, the COVID-19 pandemic further increased teachers' exposure to digital platforms (Sá et al., 2021). In mathematics, TERs are technological tools that improve students' comprehension, experience, and learning environment (Ní Shé et al., 2023) and comprise smartphones, tablets,

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laptops, and other digital tools for flexible and mobile learning and greater autonomy (Alam & Mohanty, 2023; Quan et al., 2022). Competence in the use of TERs is essential for simplifying complex concepts and fostering collaboration, requiring teachers to adapt pedagogical and content knowledge and demonstrate digital and communication skills (Joshi et al., 2023; König et al., 2020). In the Philippines, the Professional Standards for Teachers stress technology integration (DepEd Order No. 42, s. 2017) (Department of Education, 2017).

Despite the benefits, teachers face challenges in integrating TERs. These include limited training (Abbasi et al., 2021; Starks & Reich, 2023), negative attitudes (Timotheou et al., 2023), and lack of digital literacy (Hassan, 2021; Viberg et al., 2023) and are compounded by poor infrastructure, restrictive policies (Hidayat & Firmanti, 2024), minimal support, and limited access to software (Yildiz & Arpaci, 2024). Weak institutional backing lowers motivation and digital proficiency, reducing engagement and learning outcomes (Betthäuser et al., 2023; Cirneanu & Moldoveanu, 2024).

Former Education Secretary of the Phillipines, Leonor Briones, linked poor performance in the Programme for International Student Assessment (PISA) to the need for reforms and emerging technology adoption (Mateo, 2019). Current professional development (PD) mainly covers Google Workspace, Excel, and PowerPoint (Casilao et al., 2025), but teachers still need training on diverse tools to improve mathematics achievement.

Professional development in technology integration is thus crucial to address barriers and improve outcomes and should focus on multimedia and IT innovations that equip educators for effective classroom use (Chin et al., 2022). Desimone's (2009) framework, which highlights content focus, active learning, coherence, duration, and collective participation, remains a benchmark for PD design and links to gains in teacher knowledge, instructional practice, and student outcomes (Alonzo et al., 2024).

Guided by this framework, this study develops and evaluates a PD program for secondary mathematics teachers to enhance competencies in using TERs, especially graphing calculators and statistical software. Implemented as a university community extension project, it examines the effects on teachers' knowledge, skills, attitudes, and beliefs about TERs and addresses common challenges.

Despite the Philippine Professional Standards for Teachers emphasizing technology integration, secondary mathematics teachers receive limited training in TERs, resulting in gaps in their knowledge, skills, attitudes, and beliefs about these tools. Existing PD programs rarely focus on graphing calculators, Excel, and statistical software that are aligned with mathematics curricula. This study addresses this problem by developing and evaluating a PD program guided by Desimone's (2009) model to enhance teachers' competencies in TERs.

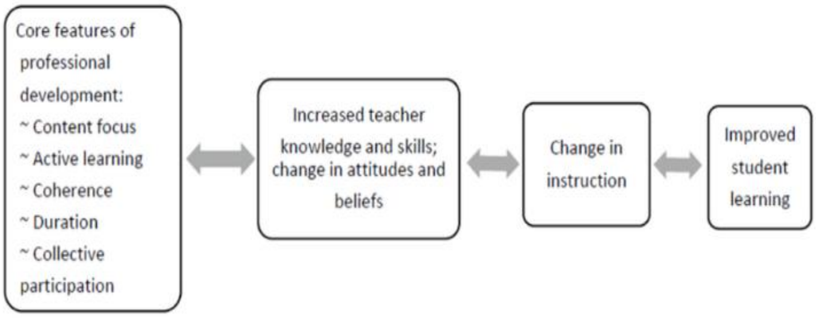

Figure 1: Conceptual Model for Professional Development
Note. Desimone, 2009

2. Methodology

This section presents a detailed description of the research methodology that was employed in this study. It covers the research design, environment, participants, instruments, data-gathering process, data analysis, and ethical considerations that governed the conduct of the study.

2.1 Preparatory Stage of the Professional Development Program

The Mathematics and Statistics faculty of a university launched a PD program on TERs for secondary mathematics teachers in Cebu, the Philippines. A training-needs assessment based on DepEd guides examined (1) perceived difficulty of Senior High School Mathematics topics, and (2) teachers' awareness of effective practices. The results (Table 1) showed that functions and graphs, hypothesis testing, and correlation and regression analyses were the most difficult to teach.

Table 1: Summary of the perceived difficulties encountered by the mathematics teachers

Content	Weighted Mean	Standard Deviation	Interpretation	Rank
A. General Mathematics				
1. Functions and their Graphs	4.05	0.57	DT	3
2. Basic Business Mathematics	2.11	0.66	SDT	8
3. Logic	2.13	0.73	SDT	7
B. Statistics and Probability				
1. Random Variables	2.61	0.75	MDT	5
2. Normal Distribution	1.85	0.71	SDT	9
3. Sampling and Sampling Distributions	2.33	0.61	SDT	6
4. Estimation of Parameters	3.07	0.73	MDT	4
5. Test of Hypothesis	4.29	0.66	VDT	2
6. Correlation and Regression Analyses	4.57	0.50	VDT	1

Note. Very Difficult to Teach (VDT)=4.21–5.00; Difficult to Teach (DT)=3.41–4.20; Moderately Difficult to Teach (MDT)=2.61–3.40; Slightly Difficult to Teach (SDT)=1.81–2.60; Not Difficult to Teach (NDT)=1.00–1.80

The second assessment used a validated questionnaire that was adapted from that of Mohamed et al. (2023) and aligned with the eight effective teaching practices of the National Council of Teachers of Mathematics (NCTM) (2014). The responses were scored on a five-point Likert scale with reverse coding for negative items. Expert feedback was incorporated, and pilot testing yielded high reliability (Cronbach's α = 0.93 and 0.91). The results (Table 2) showed that the teachers were least aware of using and linking mathematical representations effectively—essential practices for helping students to connect abstract concepts to real-world applications and strengthen problem-solving skills.

Table 2: Level of awareness of effective teaching practices among mathematics teachers

Effective Teaching Practices in Mathematics	Weighted Mean	Standard Deviation	Interpretation	Rank
1. Establishing mathematics goals that focus on learning	4.12	0.49	Agree	1
2. Performing tasks that enhance reasoning and problem-solving	3.07	0.68	Neutral	7
3. Using and linking mathematical representations	2.80	0.75	Neutral	8
4. Facilitating meaningful mathematical dialogue	3.60	0.62	Agree	5
5. Posing meaningful questions	3.59	0.59	Agree	6
6. Building procedural fluency from conceptual comprehension	3.80	0.66	Agree	3
7. Supporting productive struggle in learning mathematics	4.09	0.81	Agree	2
8. Deriving and using clues on students' thinking	3.75	0.83	Agree	4

Note. Strongly Agree=4.21–5.00, Agree=3.41–4.20, Neutral=2.61–3.40, Disagree=1.81–2.60, Strongly Disagree=1.00–1.80

When asked during their interview, some of the teachers' responses were as follows:

> "*One of the biggest challenges in teaching functions is helping students develop the ability to visualize them. Many students have a hard time understanding how an equation translates into a graph or a visual representation*" (T2).
>
> "*Performing hypothesis tests can be quite challenging for students because it involves multiple steps that require both statistical reasoning and precise calculations*" (T3).

To contextualize the findings, a demographic profile of the participating teachers was established (Table 3). Most were female, held baccalaureate degrees, and about one-third had over 20 years of service. Half of the teachers had attended only one PD on TERs, mainly on online platforms during the COVID-19 pandemic. These insights, combined with the training-needs assessment, guided the design of a targeted PD program that addressed gaps in teaching difficult mathematics topics and using technological representations and focused on graphing calculators, digital calculators, spreadsheets, and statistical software.

Table 3: Distribution of teacher-participants when grouped according to the different demographic and professional profiles

Grouping Variables	Categories	Frequency	Percentage
Sex	Male	3	20.00
	Female	12	80.00
Age in years	41 and above	5	33.33
	36–40	1	6.67
	3–35	1	6.67
	30 and below	8	53.33
Years in Service	20 and above	5	33.33
	6–10	5	33.33
	5 and below	5	33.33
Highest Educational Attainment	Master's	1	6.67
	Baccalaureate	14	93.33
Number of TER trainings attended	1	8	53.33
	2	5	33.33
	3	2	13.33

To evaluate the PD program, pre- and post-assessments following Desimone's model measured teachers' knowledge, skills, attitudes, and beliefs. Knowledge and skills were assessed using a researcher-developed questionnaire (basic skills: 7 items; advanced functionality: 8 items; problem-solving: 5 items) on a five-point Likert scale (Expert-5 to Novice-1). Teachers' beliefs were evaluated with an adapted tool from Davis et al. (1989) on a seven-point scale (7 – Strongly Agree to 1 – Strongly Disagree) for perceived usefulness (6 items) and ease of use (6 items).

Attitudes were measured using a Likert-scale questionnaire (experience: 7 items; comfort level: 5 items; ability: 3 items) with a five-point Likert scale (5 – Strongly Agree to 1 – Strongly Disagree). Additional interviews and open-ended questions explored teachers' experiences with graphing calculators and statistical software. The study was reviewed and approved by the University Extension Services Office. Moreover, all participants provided informed consent, participation was voluntary, and confidentiality and anonymity were strictly maintained.

2.2 Design and Implementation of the PD Program

The training needs and pre-assessment results informed a PD program on graphing calculators and statistical software, integrating Desimone's (2009) key elements—content focus, active learning, coherence, duration, and collective participation—to build teachers' competencies and directly link these tools to classroom practice.

2.3 Content Focus

The training program enhances teachers' competencies in using graphing calculators and statistical software to strengthen both content knowledge and pedagogy. It covers graphing functions, solving equations, and applying statistical software for descriptive and inferential statistics, correlation, and regression—topics aligned with the Senior High School Curriculum in General Mathematics, Precalculus, and Statistics and Probability. In addition, the program addresses gaps identified in the needs assessment while providing troubleshooting strategies to support independent tool use. Sample competencies are shown in tables 4 and 5. Led by the expert Mathematics and Statistics faculty, the program blends technical proficiency and pedagogy.

Trainer A specializes in applied mathematics and software integration; Trainer B brings expertise in pure mathematics and pedagogy; Teachers C and D offer statistical knowledge and teaching strategies; Teacher E, a data analyst, focuses on MS Excel for real-world applications; and Teacher F strengthens the practical use of statistical tools in classrooms, delivering a comprehensive, practice-oriented training experience.

Table 4: Competencies for the use of graphing calculators

Domain	Competencies
A. Basic Knowledge and Skills	1. Familiarizing oneself with the basic features of a digital graphing calculator.
	2. Inputting functions and equations correctly on the calculator.
	3. Navigating different modes on the calculator.
	4. Understanding graphical and numerical output.
	5. Using the calculator's memory functions.
	6. Adjusting the settings to improve visualization.
	7. Performing basic arithmetic operations (addition, subtraction, multiplication, division).
B. Advanced Functionality and Application	1. Graphing various mathematical functions (e.g., linear, quadratic, trigonometric).
	2. Using the calculator's equation solver effectively for solving algebraic equations.
	3. Analyzing data sets using the calculator.
	4. Performing calculus operations such as derivatives and integrals.
	5. Using the calculator for matrix operations (e.g., solving systems of equations).
	6. Interpreting graphical representations of mathematical concepts using the calculator.
	7. Adjusting the viewing window of graphs for better clarity.
	8. Analyzing the regression lines on the calculator.
C. Troubleshooting and Problem-Solving	1. Troubleshooting basic errors on the graphing calculator.
	2. Resolving technical issues related to the calculator's software or hardware.
	3. Resetting or clearing the calculator when errors or issues arise.
	4. Guiding students on how to use the calculator for specific tasks during class exercises.
	5. Updating or reinstalling the calculator's software if necessary.

Table 5: Competencies for the use of statistical software

	Competencies
A. Basic Knowledge and Skills	1. Understanding the basic functions and features of statistical software. 2. Navigating the user interface of the software efficiently. 3. Importing data from various sources (e.g., Excel, CSV files) into the software. 4. Organizing and cleaning data within the software. 5. Familiarizing oneself with the software's basic data-manipulation functions. 6. Saving and exporting data and results from the software. 7. Entering basic data manually into the statistical software when needed.
B. Data Analysis and Statistical Procedures	1. Performing descriptive statistics in the software. 2. Performing inferential statistical tests using the software. 3. Using the software to conduct correlation and regression analyses. 4. Creating and interpreting various charts and graphs. 5. Performing non-parametric tests. 6. Interpreting the output provided by the software for different statistical tests. 7. Using the software for predictive modelling. 8. Performing sampling and creating random data sets for statistical analysis.
C. Troubleshooting and Problem-Solving	1. Troubleshooting common software errors (e.g., data import errors, missing values). 2. Resolving software issues when encountered during assignments or projects. 3. Managing data types within the software. 4. Resetting or reformatting data sets within the software if errors occur during analysis. 5. Accessing and using online resources for troubleshooting software problems.

2.4 Active Learning

An essential consideration in designing the PD program was incorporating active learning to fully engage teachers in the learning process. Active learning strategies provide hands-on, participatory experiences in which teachers observe others, receive feedback, and practice new teaching techniques, thus enhancing skill acquisition and fostering reflection.

Guided by Fink's (2003) holistic model (Watanapokakul, 2024), the program integrates three components: (1) communication of information and ideas through readings, instruction, or presentations; (2) experiences that include both 'doing' and 'observing' activities such as demonstrations; and (3) reflection through individual or group activities that encourage teachers to critically evaluate and adapt new methods. These components are embedded throughout the design of the PD program.

Table 6: Characterization of the professional development program according to Desimone's (2009) model

Content	Active Learning Component	Duration	Coherence	Collective Participation
Domain A	**Communication of Information and Ideas:** Teachers receive foundational knowledge and strategies for using graphing calculators and statistical software contextualized to curriculum needs. **Reflection:** Teachers engage in collaborative learning to share insights, challenges, and strategies.	4 sessions (2 per TER) 48 hours	**External coherence:** Aligned with the PPST (DepEd Order No. 42, s. 2017), MELCs, and the UN SDG 4 on Quality Education. Formalized through an MOA. **Internal coherence:** Introduces core knowledge and skills needed for later application. **Coherence creation:** Encourages reflective discussions and shared goals within learning	All secondary mathematics teachers in the school All Mathematics and Statistics faculty members in a university
Domain B	**Experience – 'Doing':** Teachers work in small groups to practice using graphing calculators or statistical software. **Experience – 'Observing':** Teachers demonstrate to peers and observe skilled facilitators or peers.	4 sessions (2 per TER) 48 hours		
Domain C	**Communication of Information and Ideas:** Teachers are presented with troubleshooting scenarios to resolve collaboratively.	1 session 8 hours		

TER: Technology-enhanced resource; PPST: Philippine Professional Standards for Teachers; MELCs: Most Essential Learning Competencies; UN SDG: United Nations Sustainable Development Goal

2.5 Coherence

Coherence in PD reflects alignment with teachers' knowledge, beliefs, prior learning, and broader educational policies (Hennessy et al., 2022). This PD program ensured external coherence by aligning with the Philippine Professional Standards for Teachers (DepEd Order No. 42, s. 2017), institutional priorities as a university-approved community extension initiative, and United Nations Sustainable Development Goal 4 on Quality Education.

The program was formalized through a Memorandum of Agreement with the partner school. Internal coherence was achieved through a sequenced design building foundational knowledge (Domain A), applied practice (Domain B), and contextual problem-solving (Domain C). Coherence creation was fostered by promoting teacher agency through collaborative dialogue, reflection, and co-construction of instructional goals, establishing a professional learning community.

2.6 Duration

The training program comprised 10 sessions totaling 72 hours, with 9 sessions devoted to core activities. Sessions were organized into three domains: Domain A (4 sessions—2 on graphing calculators and 2 on statistical software), Domain B (4 sessions with the same distribution), and Domain C (1 session). Session allocation was jointly planned by the project team and the school to accommodate teachers' schedules. More time was assigned to domains A and B to cover foundational topics and their practical applications.

2.7 Collective Participation

Collective participation refers to the extent to which multiple teachers from the same school engage in the same professional learning opportunities. In the context of this PD program, all secondary mathematics teachers from the same school were selected as participants. This collective involvement developed a shared learning environment, enabling collaboration, the exchange of ideas, and the alignment of teaching practices across the school, ultimately enhancing the program's impact on both teaching and student outcomes.

2.8 Evaluation of the PD Program

The training program provided teachers with essential knowledge and skills for using graphing calculators and statistical software although their application to specific teaching practices remained underexplored. To assess the program's impact, a post-assessment using the same pre-assessment questionnaire aligned with Desimone's model was conducted to document changes in teachers' competencies, beliefs, and attitudes. A paired-sample *t*-test was used to evaluate significant differences between pre- and post-assessment responses.

3. Results and Findings

3.1 Teachers' Perceived Competence

Desimone's (2009) model highlights the measurement of changes in teachers' content and pedagogical knowledge as mediators of improved teaching practices in PD. In this program, teachers perceived competence in three domains on graphing calculators and statistical software was assessed. Pre-assessment results showed 'Immediate' competence, with mean scores of 3.17 (SD = 0.73), 3.34 (SD = 0.48), and 3.40 (SD = 0.49) for Domains A, B, and C, respectively. Post-assessment scores rose to 'Expert', with means of 4.55 (SD = 0.52), 4.39 (SD = 0.58), and 4.24 (SD = 0.67), respectively.

Table 7: Teacher's perceived competence in using graphing calculators

Domain	Survey	Response *Mean*	*SD*	Category	Mean Difference	*t*	*p*	Effect Size
A. Basic Knowledge and Skills	Pre-Assessment	3.17	0.73	Intermediate	1.38	13.93	0.00*	3.60
	Post-Assessment	4.55	0.52	Expert				
B. Advanced Functionality and Application	Pre-Assessment	3.34	0.48	Intermediate	1.05	21.20	0.00*	5.47
	Post-Assessment	4.39	0.58	Expert				
C. Troubleshooting and Problem-Solving	Pre-Assessment	3.40	0.49	Intermediate	0.84	11.42	0.00*	2.95
	Post-Assessment	4.24	0.67	Expert				

*$p < 0.05$. There is a significant difference

Teacher's perceived competence in statistical software was initially 'Intermediate', with mean scores of 3.13 (*SD* = 0.68), 3.07 (*SD* = 0.58), and 2.95 (*SD* = 0.75) for Domains A, B, and C, respectively. Post-assessment scores improved to 4.40 (*SD* = 0.55), 4.28 (*SD* = 0.53), and 4.17 (*SD* = 0.64), respectively. Statistical tests confirmed significant gains across all domains: for graphing calculators, t = 13.93 (p = 0.00), 21.20 (p = 0.00), and 11.42 (p = 0.00); and for statistical software, t = 14.77 (p = 0.00), 18.98 (p = 0.00), and 11.91 (p = 0.00) for Domains A, B, and C.

Table 8: Teacher's perceived competence in using statistical software

Domain	Survey	Response *Mean*	*SD*	Category	Mean Difference	*t*	*p*	Effect Size
A. Basic Knowledge and Skills	Pre-Assessment	3.13	0.68	Intermediate	1.26	14.77	0.00*	3.81
	Post-Assessment	4.40	0.55	Expert				
B. Data Analysis and Statistical Procedures	Pre-Assessment	3.07	0.58	Intermediate	1.21	18.98	0.00*	4.90
	Post-Assessment	4.28	0.53	Expert				
C. Troubleshooting and Problem-Solving	Pre-Assessment	2.95	0.75	Intermediate	1.23	11.91	0.00*	3.08
	Post-Assessment	4.17	0.64	Expert				

*$p < 0.05$. There is a significant difference

Overall, these findings indicate a significant improvement in teachers' perceived competencies with both types of TERs. Domain A exhibited the greatest mean difference between pre- and post-assessments, with increases of 1.38 for graphing calculators and 1.26 for statistical software. This improvement underscores the effectiveness of the PD program in enhancing teachers' skills and confidence in using these tools. Interesting narratives from two teachers during their interviews are presented below:

> *"We do not usually use these technologies because they were not covered during our college education. Some are fortunate to have enrolled in a master's program, where these tools may have been discussed in research classes"* (T1).

> *''The training has given us new knowledge and skills that we have not learned before because we are so accustomed to our traditional ways of teaching, especially given the need to catch up with other competencies. Now that we have learned about these tools and their potential applications in our classes, we are hopeful that we can integrate them into our instruction. ''* (T2)

Ibda et al. (2023) stress that professional teaching extends beyond initial certification and requires ongoing PD through participation in programs, activities, and partnerships, with strengthened ICT skills being essential to meet modern educational demands. Actively engaging teachers in PD builds competencies aligned with their instructional needs, enhancing educational quality, improving teacher performance, developing well-rounded students (Nguyen et al., 2021), and achieving institutional goals, as reinforced by the university's PD initiatives with secondary schools.

Likewise, Hill et al. (2020) highlight that PD is most effective when it builds practical knowledge that is directly applicable to instruction—understanding curriculum materials, mastering content and its representation, and developing insights into student learning—ensuring that PD content aligned with the curriculum supports instructional coherence and effective teaching.

3.2 Teachers' Perceived Beliefs

Teachers' beliefs reflecting their convictions about learning, content, roles in PD programs, and expectations for TERs are crucial in shaping sustained classroom change. The statistical analysis showed significant gains in these beliefs after the PD program; for graphing calculators (Table 9), perceived usefulness rose from 5.37 (*SD* = 0.53, Agree) to 6.55 (*SD* = 0.66, Strongly Agree; mean difference = 1.18; t = 14.62; p = 0.00), while perceived ease of use increased from 4.65 (*SD* = 0.64, Somewhat Agree) to 6.76 (*SD* = 0.50, Strongly Agree; mean difference = 1.90; t = 24.45; p = 0.00).

Table 9: Teachers' perceived beliefs in using graphing calculators

Variable	Response				Mean Difference	t	p	Effect Size
	Survey	*Mean*	*SD*	Category				
Perceived Usefulness	Pre-Assessment	5.37	0.53	Agree	1.18	14.62	0.00*	3.77
	Post-Assessment	6.55	0.66	Strongly Agree				
Perceived Ease of Use	Pre-Assessment	4.65	0.64	Somewhat Agree	1.90	24.45	0.00*	6.31
	Post-Assessment	6.76	0.50	Strongly Agree				

*p < 0.05. There is a significant difference

Table 10 shows the results for the teachers' perceived beliefs on the use of statistical software. The results on the perceived usefulness significantly increased from 5.41 (*SD* = 0.67), or Agree, to 6.76 (*SD* = 0.43), or Strongly Agree, showing a mean difference of 1.34 (t = 14.27, p = 0.00). Similarly, the perceived ease of use significantly increased from 4.50 (*SD* = 0.50), interpreted as Somewhat Agree, to

6.54 (*SD* = 0.50), interpreted as Strongly Agree, with a mean difference of 2.04 (t = 22.62, p = 0.00).

Table 10: Teachers' perceived beliefs in using statistical software

Variable	Response				Mean Difference	*t*	*p*	Effect Size
	Survey	*Mean*	*SD*	Category				
Perceived Usefulness	Pre-Assessment	5.41	0.67	Agree	1.34	14.27	0.00*	3.68
	Post-Assessment	6.76	0.43	Strongly Agree				
Perceived Ease of Use	Pre-Assessment	4.50	0.50	Somewhat Agree	2.04	22.62	0.00*	5.84
	Post-Assessment	6.54	0.50	Strongly Agree				

*$p < 0.05$

These significant gains highlight the effectiveness of the PD program in strengthening teachers' technological beliefs. Before training, teachers showed only moderate agreement on the usefulness of the tools and demonstrated some uncertainty about ease of use; after training, they strongly agreed on both, reflecting greater competence, confidence, and readiness to integrate TERs. This shift underscores how targeted, hands-on PD fosters both technological skills and pedagogical confidence and encourages teachers to adopt graphing calculators and statistical software to improve teaching and student engagement. The following narratives illustrate the participants' beliefs and experiences regarding TERs:

> *''I have not had the opportunity to learn these tools before, so I am not familiar with their procedures. I also did not use this on class because I believed that I wasn't knowledgeable enough to implement them. However, I believe that learning all these tools is relevant to my profession. ''* (T3)
>
> *''For me, it feels challenging because I have only recently learned the statistical concepts and the various processes involved in using the software. The last time we had training on technology resources was during the COVID-19 pandemic, which focused primarily on using online platforms for our classes. I am grateful to be part of this training and look forward to gaining more knowledge and skills in the upcoming sessions. ''* (T4)

Rodgers et al. (2022) note that although teachers may learn new procedures during PD, they may resist adopting them if they do not perceive that there are benefits for students. In addition, Thurm and Barzel (2020) similarly observe that PD has limited impact on beliefs when such concerns are not addressed. In this PD initiative, pre-assessment results showed that teachers were moderately receptive to the tools, finding them easy to use but lacking full understanding of their potential due to limited classroom integration. After hands-on engagement, collaborative discussions, and facilitator support, teachers developed stronger skills and beliefs in the effectiveness of the tools, fostering a more positive attitude toward their curricular use and illustrating the transformative potential of well-structured PD.

3.3 Teachers' Perceived Attitude

Teachers' attitudes toward PD influence both participation and sustained practice, and Desimone's model highlights that relevance, coherence, and support enhance effectiveness. Results showed marked improvement after the PD program; for graphing calculators (Table 11), pre-assessment means of experience (3.40, *SD* = 0.49), ability (3.38, *SD* = 0.49), and comfort (3.51, *SD* = 0.53) rose to 4.62, 4.76, and 4.71 (all Strongly Agree; *t* = 16.17, 16.09, 13.42; *p* = 0.00). Similarly, for statistical software (Table 12), pre-assessment scores of 3.35, 3.38, and 3.88 increased to 4.59, 4.76, and 4.76 (*t* = 21.12, 17.47, 8.88; *p* = 0.00), showing significant growth across all aspects.

Table 11: Teachers' perceived attitude in using graphing calculators

Variable	Response				Mean Difference	*t*	*p*	Effect Size
	Survey	***Mean***	***SD***	**Category**				
Experience with Graphing Calculators	Pre-Assessment Post-Assessment	3.40 4.62	0.49 0.51	Undecided Strongly Agree	1.22	16.17	0.00*	4.18
Comfort in Using Graphing Calculators	Pre-Assessment Post-Assessment	3.51 4.71	0.53 0.43	Agree Strongly Agree	1.20	13.42	0.00*	3.47
Ability to Use Graphing Calculators	Pre-Assessment Post-Assessment	3.38 4.76	0.49 0.43	Undecided Strongly Agree	1.38	16.09	0.00*	4.15

*p < 0.05

Table 12: Teachers' perceived attitude in using statistical software

Variable	Response				Mean Difference	*t*	*p*	Effect Size
	Survey	***Mean***	***SD***	**Category**				
Experience with Statistical Software	Pre-Assessment Post-Assessment	3.35 4.59	0.48 0.49	Undecided Strongly Agree	1.24	21.12	0.00*	5.45
Comfort in Using Statistical Software	Pre-Assessment Post-Assessment	3.88 4.76	0.57 0.46	Agree Strongly Agree	0.88	8.88	0.00*	2.29
Ability to Use Statistical Software	Pre-Assessment Post-Assessment	3.38 4.76	0.49 0.43	Undecided Strongly Agree	1.38	17.47	0.00*	4.51

* *p* < 0.05

These findings suggest a meaningful positive shift in teachers' attitudes brought about by the PD program. Initially uncertain and hesitant, teachers became more confident, comfortable, and capable in using these technological tools after structured and targeted training. The results affirm that well-designed PD programs can address initial apprehensions, strengthen teachers' confidence, and ultimately foster greater integration of TERs into instructional practice. The teachers experienced this in regard to TERs after the PD program:

> *''I usually stuck to manual solutions or visual aids on the board because I wasn't sure how to integrate technology effectively into my lessons. I also believed that only tech-savvy teachers could use such tools well. Now, I feel much more confident and excited to use graphing calculators in my teaching. ''*(T4)
>
> *''I was intimidated by statistical software. It looked too complicated, and I always thought it was only for research or advanced users. I rarely used it in class because I didn't feel comfortable navigating its features. The PD program helped me overcome that fear. After learning step-by-step how to use statistical software for basic analyses, I realized it could make my lessons more practical. ''* (T5)

Despite positive attitudes toward technology, many educators remain reluctant to integrate it into their classrooms due to technical challenges, limited advanced skills, and low self-assurance in using such tools (Zhang, 2022). This reluctance is compounded by insufficient PD regarding technology, leaving teachers uncertain about its academic and theoretical applications.

Since teacher attitudes are critical to the effectiveness of PD, their initial perspectives often determine program success, with positive attitudes enhancing knowledge acquisition and skill development. Therefore, PD programs must be designed as continuous, reflective processes that foster teachers' motivation, commitment, and confidence while addressing evolving student-learning needs to improve the quality of mathematics teaching and learning.

4. Conclusion and Recommendations

The design and evaluation of this PD program provided teachers with a transformational experience, empowering them to use TERs effectively. This acquired knowledge and skill set is poised to improve instructional practices and enhance the mathematics curriculum, paving the way for innovative teaching and learning experiences. However, while the program yielded positive outcomes, its small sample size and single-school focus limit the generalizability of the findings.

Addressing these limitations in future research through, for example, exploring long-term classroom integration, impacts on student outcomes, and implementation across varied contexts is crucial. At the policy level, stronger support from DepEd and partnerships with universities are recommended to scale similar PD initiatives, ensuring teachers gain sustained access to training, technical support, and digital resources.

5. Conflict of Interest

The authors declare no conflict of interest.

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