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Research Article

Enhancing Grade 11 Students' Academic Performance in Statistics and Probability Through Magnified Math Solutions Strategy

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ABSTRACT

The poor academic performance in Statistics and Probability has been one of the significant challenges in teaching and learning during the COVID-19 pandemic, especially under modular distance learning. This action research aimed to improve the academic performance of Grade 11 TVL ICT-CSS learners at Kinan-oan High School, Trinidad II District, through the *Magnified Math Solutions Strategy* during School Year 2021–2022. The strategy was designed to enhance learners' metacognitive skills by using a Learning Progress-Inquiry Form to gather self-assessments and specific learning inquiries. These inputs guided the creation of detailed math solutions and differentiated supplementary activities tailored to students' individual learning needs. Twenty-seven (27) learners participated in the study. A comparative analysis of their academic performance before and after the intervention revealed an improvement: learners classified as Fairly Satisfactory decreased from eleven (11) to three (3). The mean academic performance increased from 81.70% to 86.26%, showing a 4.56% gain. A paired sample t-test yielded a t-statistic of 37.54 and a p-value of < .001, indicating a statistically significant difference in learners' performance before and after the intervention. The findings suggest that the *Magnified Math Solutions Strategy* is effective in improving academic performance in Statistics and Probability by promoting metacognition, differentiated instruction, and self-directed learning. However, since the study was conducted during modular distance learning with a small sample size, further research is recommended to validate its effectiveness in face-to-face settings and across more diverse learner populations.

Keywords: *Magnified Math Solutions Strategy, Statistics and Probability, Academic performance, Metacognition, Comparative analysis*

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Introduction

Statistics is a branch of mathematics that governs the collection, analysis, interpretation, and presentation of data in a systematic and scientific manner. Probability, as a mathematical language, is used to understand and express these ideas. Moreover, it explains variations in measurement and data collection, which are vital in research and data development (UCI Department of Statistics, 2021).

As explained by Dr. Hollylynne Lee, a mathematics and statistics professor, in an interview with Bowen (2021), exposure to statistics and probability in daily contexts allows learners and educators to connect these concepts to real-life scenarios. This, in turn, helps them make wiser decisions and empowers them to pursue greater opportunities in life.

In support of this, the K to 12 Basic Education Program aims to produce holistically developed, lifelong learners prepared for higher education. The Senior High School curriculum includes Statistics and Probability as one of its core subjects due to its wide range of real-life applications.

However, the study by Repedro et al. (2021), entitled *Attitudes Towards Statistics and Statistical Literacy of Public Senior High School Students*, revealed underwhelming results in the development of statistical knowledge and skills. Statistical literacy was found to be only fairly satisfactory in most competencies. Chiesi et al. (2010), as cited by Retutas (2021), noted that low mastery of foundational skills in Statistics and Probability leads to poor performance in more advanced competencies in the field.

The Programme for International Student Assessment (PISA), in its 2018 evaluation of educational systems, revealed that the Philippines performs below the average scholastic mark in mathematics compared to other PISA-participating nations.

In addition to these factors, the shift in the educational landscape brought about by the COVID-19 pandemic has also contributed to poor academic performance in Statistics and Probability. The Department of Education adopted modular distance learning and only recently began reopening schools for limited face-to-face classes.

These learning conditions provide opportunities for educators to integrate teaching strategies and innovations that address students' academic needs and learning paces, while also promoting higher-order thinking skills (HOTS) and metacognition. As Danial (2010), cited by Ismanisa and Nughara (2019), explained, metacognition is the process by which learners independently evaluate their understanding of the subject matter.

Furthermore, Silk et al. (2017), citing Kolb and Kolb (2002), highlighted the importance of metacognitive concepts in experiential learning through activity-based approaches. They emphasized that in order for students to fully benefit from learning opportunities, activities must be tailored to their academic needs. This is where differentiated instruction becomes essential. As defined by Anderson et al. (2008), cited in the study by Ismajli and Imami-Morina (2018), differentiated instruction is a responsive teaching method that adapts to learners' individual paces, levels, and needs.

In a quasi-experimental research conducted by Wang (2023), students were grouped by ability levels and taught math using the cognitive apprenticeship framework, which includes modeling, coaching, and scaffolding. The study showed that this stratified and structured approach significantly improved students' math achievement compared to traditional instruction methods. The improvements were particularly notable among lower- and middle-achieving students, suggesting that ability-based grouping, combined with metacognitive instructional strategies, enhances both understanding and retention.

The study of Daher et al. (2020) suggests that programming in environments like Scratch, when combined with reflective dialogue and guided problem-solving, can effectively enhance certain metacognitive skills in teacher training, particularly those related to active regulation like planning and monitoring, more than those related to awareness or self-evaluation.

The 2025 scoping review by Gao, Evans, and Fergusson explores how student explanation strategies—like explaining to oneself, peers, or imagined others—support learning in postsecondary mathematics and statistics.

These strategies, rooted in metacognitive and generative learning theories, can meaningfully enhance cognitive performance.

The above-mentioned teaching and learning principles and related studies shows the potence of metacognition and self-directed learning which can help address the gaps and challenges in the "new normal" of education, particularly at the grassroots level.

At Kinan-oan High School, the Quarterly Report Assessment in Statistics and Probability for the Third Quarter of School Year 2021–2022 revealed concerning results. Among the 27 enrolled Grade 11 Humility students, only 3 learners (11.11%) achieved an Outstanding academic performance (90–100), and 4 learners (14.81%) were categorized as Very Satisfactory (85–89). Nine learners (33.33%) received a Satisfactory rating (80–84), while a significant number—11 learners or 40.74%—were only Fairly Satisfactory, with scores ranging from 75 to 79.

This poor academic performance in Statistics and Probability prompted the researcher to design and implement the *Magnified Math Solutions Strategy*, anchored on the principles of metacognition, experiential learning, and differentiated instruction. This strategy follows a multi-step process involving learners' self-assessment and the provision of differentiated supplementary activities.

Using a Learning Progress-Inquiry Form, learners will assess their understanding and identify their learning difficulties. In response, the teacher will provide detailed math solutions and explanations, along with differentiated supplementary activities. This approach aims to foster self-directed learning by addressing individual learning needs and providing targeted support, thus coining the term "magnified."

Therefore, there is a need to implement the *Magnified Math Solutions Strategy* to enhance the teaching and learning process, with the goal of improving the academic performance of Grade 11 Humility students in Statistics and Probability.

Methods

Design

This study employed an action research design utilizing a quasi-experimental approach. The quasi-experimental design is a research method that aims to identify the impact of a particular intervention, program, or event by comparing the dependent variable before and after the implementation of the intervention through comparative analysis. Since this study used a quasi-experimental design, no control group was included. The participants were selected through purposive sampling. In the context of this study, the academic performance of the experimental group served as the primary variable.

In addition, the descriptive method was used, supported by the Learning-Inquiry Form and the academic performance data of the learner-participants, which were utilized for comparative analysis.

Participants

The learner-participants were the purposively selected 27 students enrolled in the TVL ICT-CSS strand of Grade 11 Humility at Kinan-oan High School during the second semester of School Year 2021–2022. The selection was based on data gathered from the Quarterly Assessment Results, specifically from the third quarter of the same school year. During this period, 11 out of the 27 students (40.74%) in Grade 11 Humility were classified as fairly satisfactory, having achieved academic performance scores ranging from 75 to 79.

Data Gathering Methods

This action research employed a quantitative method for data gathering. It involved the use of a Learning Progress-Inquiry Sheet, which consisted of two parts: self-assessment and learning difficulties and inquiries. The learners' responses and questions in the sheet were addressed with detailed math solutions and explanations. Based on their identified difficulties and inquiries, differentiated supplementary activities were provided to help them understand and apply the given solutions and

explanations. Finally, the learners' academic performance in Statistics and Probability for the third and fourth quarters was used for comparative analysis.

Intervention/Strategy

This action research utilized the *Magnified Math Solutions Strategy* to address the poor assessment results in Statistics and Probability. The strategy is a multi-step approach anchored on the principles of metacognition, experiential learning, and differentiated instruction. It enabled the learner-participants to assess and re-evaluate their own learning based on the provided magnified math solutions and differentiated supplementary activities, which were implemented through modular distance learning.

Pre-Implementation

The research proponent coordinated with the School Learning Action Cells (SLAC) Coordinator to secure approval from the School Principal and the Public Schools District Supervisor. This allowed all mathematics teachers at Kinan-oan High School to be involved in the presentation of the research plan, proposed timelines, and the implementation of the *Magnified Math Solutions Strategy*.

To ensure the participation of parents, students, and teachers, an orientation was conducted to explain the process and importance of the study. During this orientation, copies of the parent consent forms were distributed and subsequently collected.

The researcher utilized self-learning modules from the Schools Division of Bohol Learning Resources Center, which were disseminated for use during distance learning. A Learning Progress-Inquiry Sheet was also prepared and attached to the self-learning modules as part of the intervention. Additionally, the researcher created differentiated supplementary activities for each learner on a weekly basis. All materials and tools used in this study underwent quality assurance by the school's quality assurance team.

Implementation

The *Magnified Math Solutions Strategy* was implemented throughout the fourth quarter on a weekly basis, spanning a total of eight weeks.

A Learning Progress-Inquiry Form was attached to the self-learning modules each week. This form consisted of two parts: the first part was a self-assessment, which allowed learners to reflect on and evaluate their own learning; the second part was a learning inquiry, where learners were asked to identify specific parts of the self-learning modules they found difficult to understand. Learners were allowed to write their responses in Bisaya to help them clearly express their questions.

In response to the learners' inquiries and difficulties, detailed math solutions and explanations were provided. These served as tools to help learners re-evaluate and improve their understanding of the concepts.

In addition, a 30-item differentiated supplementary activity was given, specifically designed to address each student's individual learning inquiries and difficulties. These activities aimed to help students apply and internalize the math solutions and explanations provided, thereby strengthening their learning.

All the magnified math solutions were returned to the learners during the scheduled weekly module distribution. These solutions supported learners in mastering the least-mastered skills and competencies, as evidenced by improved performance in their summative assessments and performance tasks. This strategy emphasized that learners can assess and re-assess their own learning through the provision of detailed math solutions, while also promoting self-directed learning.

Post Implementation

The findings of the study were disseminated to the school and district governing bodies, and eventually to the Division Office for appropriate action. At the school level, the results were shared through a school-based Learning Action Cell (SLAC) session.

A discussion on the implementation process was conducted to support the strategy's adoption and utilization across grade levels within the school.

The results were also communicated to other institutions in the school district through research presentations and colloquia, as well as during the District In-Service Training (INSET).

Ethical Consideration

The ethical considerations of this action research contain the principles that guide the researcher in the research design and practices such as the participation of the participants and confidentiality of the data. It was made clear to the respondents/participants that their participation in this study was voluntary and that they were not compelled to participate should they believe detrimental to their interest. Furthermore, the respondents/participants were informed that the research was conducted solely for academic purposes and the data gathered from them should be exclusively used for such purposes.

The research ensured the confidentiality of the gathered data relative to the personal information of the respondents/participants of this study and were not disclosed to the public at any cause. This guaranteed by the following activities: The names of the respondents were replaced by codes. The sheet containing the name of the respondents was removed and were kept or destroyed when no longer needed for the research. The researcher had the sole access to the code's master list. Files containing research data were password protected and encrypted to keep the data safe.

The interest of the respondents or participants was protected by Republic Act 10173 also known as the Data Privacy Act of 2012, henceforth, any pertinent data or information of the respondents/participants of this study were not accessed, transported, or copied without the approval and consent of the Regional Research Committee.

Limitations

This study employed a quasi-experimental design without a control group, which limits the ability to establish a clear causal relationship between the intervention and the observed improvement in academic performance. Without a comparison group, other influencing factors—such as student motivation, teacher support, or external learning conditions—may have contributed to the results. As such, the findings should be interpreted as indicative rather than conclusive evidence of the strategy's effectiveness.

Additionally, the small sample size of only 27 learners from a single class in one school limits the generalizability of the results. The study was also conducted during modular distance learning, which may have introduced uncontrollable variables such as differing levels of parental support, learner engagement, and access to learning resources. Future research involving a larger sample, more diverse settings, and a controlled experimental design is recommended to validate and strengthen the findings.

Data Analysis

Descriptive statistics was used for the analysis of the data gathered throughout the implementation process. Specifically, to determine the learner-participants' profile in terms of their academic performance before and after the implementation of Magnified Math Solutions Strategy and the mean scores and mean percentage scores, frequency count and simple percentage formula were utilized. Also, to determine the improvement of learners' academic performance before and after the implementation of Magnified Math Solutions Strategy, the mean difference formula was used.

Discussion of Results and Reflections

This chapter presents the findings of the study, its analysis and interpretation. It covers the academic performance of the learners before and after the implementation of Magnified Math Solutions Strategy, the mean scores in the differentiated supplementary activity as reflected on the learning progress-inquiry form, conclusions drawn from the findings, and recommendations for future planning and implementation.

Results

Table 1. Academic Performance of Learners Before the Implementation of Magnified Math Solutions Strategy

Interval	Description	Before the Implementation	
		f	%
90-100	Outstanding	3	11.11
85-89	Very Satisfactory	4	14.81
80-84	Satisfactory	9	33.33
75-79	Fairly Satisfactory	11	40.74
74 and below	Did not meet expectation	0	0
TOTAL		27	100

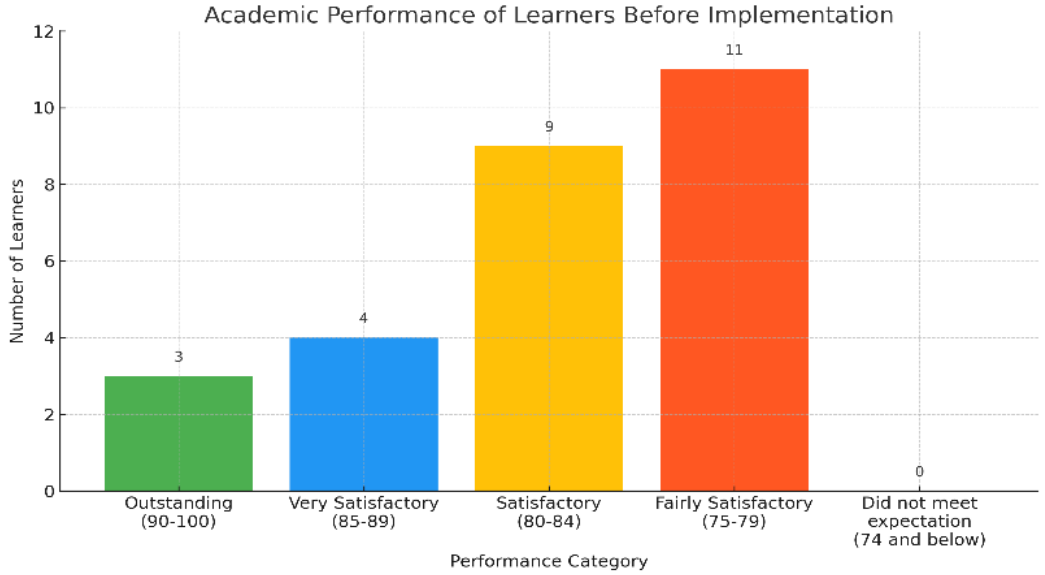

Table 1 shows the academic performance of the Grade 11 TVL ICT-CSS learners before the implementation of Magnified Math Solutions Strategy. There were 3 learners (11.11%) who were Outstanding with an academic performance ranging from 90-100, 4 learners (14.81%) were Very Satisfactory with an academic performance of 85-89, 9 learners (33.33%) were Satisfactory with an academic performance of 80-84.

Meanwhile, a significant number of 11 learners which is equivalent to 40.74% of the total enrolment of Grade 11 Humility were fairly satisfactory who only achieved an academic performance ranging from 75 to 79. This implies that a significant number of learners needs intervention and strategies to improve their academic performance.

Table 2. Mean Scores and Mean Percentage Scores (MPS) of Learners on the Differentiated Supplementary Activities During the Implementation of Magnified Math Solutions Strategy

Week	Mean Score (30 items)	Mean Percentage Scores (MPS)
1	24.22	80.73%
2	22.15	73.83%
3	22.89	76.30%
4	22.04	73.47%
5	23.22	77.40%

Week	Mean Score (30 items)	Mean Percentage Scores (MPS)
6	23.81	79.37%
7	22.41	74.70%
8	22.88	76.27%
Average	**22.95**	**76.50%**

Table 2 shows the mean scores of the learners on the 30-item differentiated supplementary activities based on the learning progress-inquiry form as part of the eight-week implementation of the Magnified Math Solutions Strategy.

In the eight-week run of the implementation of Magnified Math Solutions Strategy, it shows that the learners consistently work well on the given 30-item differentiated supplementary activities which was designed based on their inquiries reflected on the learning progress-inquiry form.

The over-all mean scores of the learners throughout the implementation of Magnified Math Solutions Strategy is 22.95 out of 30 items. This is equivalent to 76.50% mean percentage score (MPS) which eventually passed on the 75% passing percentage standard in the Department of Education.

This implies a positive result on their progress with the aid of differentiated supplementary activities. The result is supported by Anderson et. al (2008) as cited from the study of Ismajli and Imami-Morina (2018) which states that differentiated instruction is a responsive instructional method which caters on the learners' academic pace, level and needs.

Table 3. Academic Performance of Learners After the Implementation of Magnified Math Solutions Strategy

Interval	Description	After the Implementation	
		f	%
90-100	Outstanding	11	40.74
85-89	Very Satisfactory	1	3.70
80-84	Satisfactory	12	44.44
75-79	Fairly Satisfactory	3	11.11
74 and below	Did not meet expectation	0	0
	TOTAL	27	100

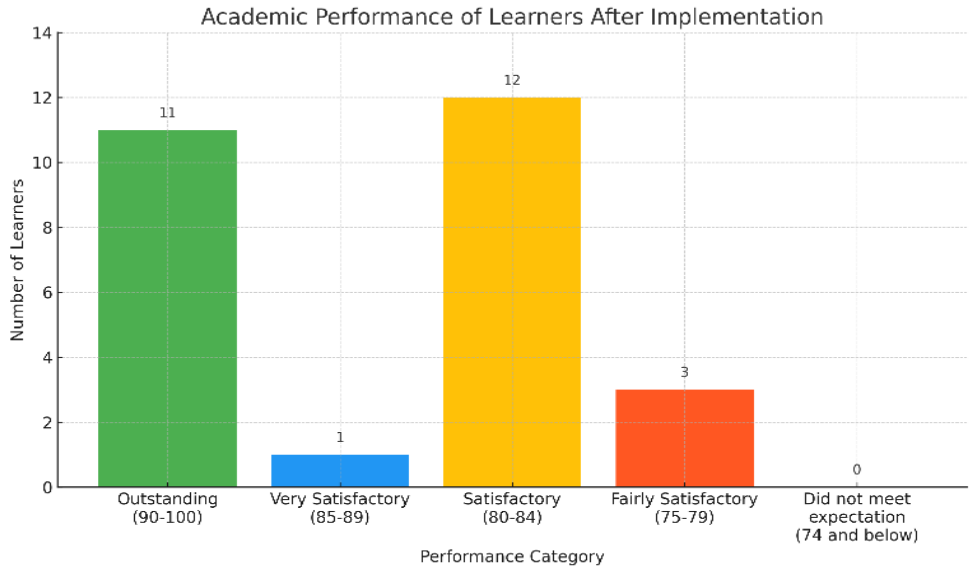

Table 3 shows the academic performance of the Grade 11 TVL ICT-CSS learners after the implementation of Magnified Math Solutions Strategy. The result after the implementation of Magnified Math Solutions Strategy transpired that 11 leaners achieved an academic performance of 90-100 which is described as Outstanding. Also, 1 learner (3.70%) on the 85-89 range and 12 learners (44.44%) as Satisfactory on the 80-84 range of academic performance. However, there 3 learners (11.11%) who are Fairly Satisfactory with an academic performance of 75-79.

This result indicates the positive impact of Magnified Math Solutions Strategy in coherence to the result in Table 2.

Table 4. Difference Between the Mean Academic Performance of Learners Before and After the Implementation of Magnified Math Solutions Strategy

Mean		Mean Difference	t-statistic	p-value	Interpretation
Before	**After**				
81.70	86.26	4.56	37.54	<.001	There is a significant difference before and after the implementation of Magnified Math Solution Strategy

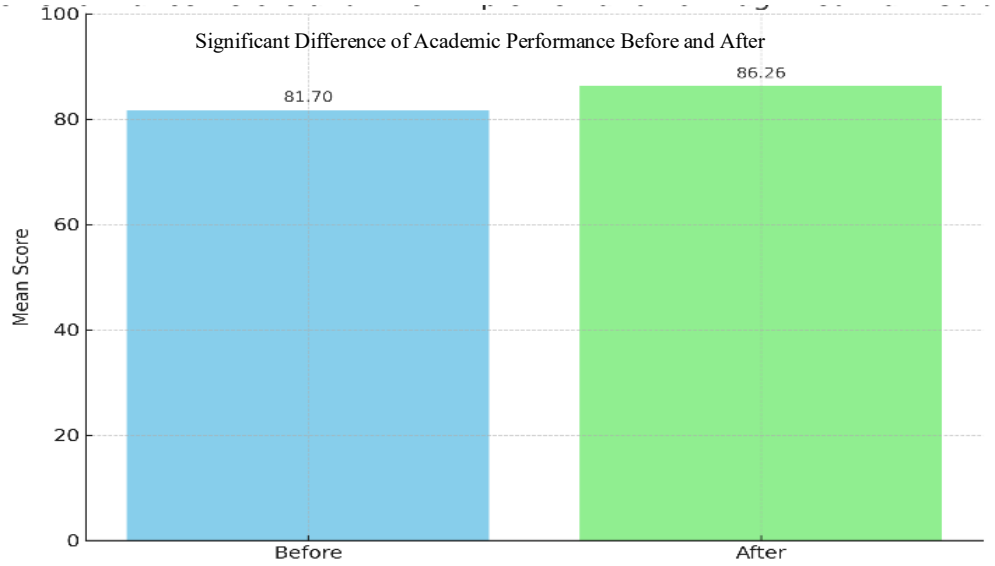

Table 4 shows that the statistical analysis which warrants to the decision that the implementation of the *Magnified Math Solutions Strategy* led to a significant improvement in learners' academic performance. The mean score increased by approximately 5.67 points, and the p-value < .001 indicates that this improvement is highly statistically significant. These findings support the effectiveness of the strategy in enhancing students' understanding and mastery of concepts in Statistics and Probability.This result indicates the effectiveness of the intervention in improving student achievement in Statistics and Probability. The observed improvement can be attributed to three key elements integrated into the strategy: metacognition, differentiated instruction, and the format of feedback provided.

The use of a learning progress-inquiry form encouraged learners to reflect on their own understanding and identify specific areas of difficulty, thereby developing their metacognitive awareness and self-regulation. By recognizing their learning gaps, students were more engaged in the process of re-evaluating their understanding. The strategy also incorporated

differentiated instruction by providing supplementary activities tailored to each learner's unique learning inquiries. This personalized approach ensured that learners received appropriate support based on their academic needs and pace, leading to more meaningful learning experiences. Furthermore, the individualized feedback—through detailed math solutions and explanations—allowed students to clarify their misconceptions and build deeper conceptual understanding.

These findings are supported by the 2025 scoping review conducted by Gao, Evans, and Fergusson, which explored how explanation strategies—such as explaining to oneself, peers, or imagined others—enhance learning in postsecondary mathematics and statistics. Rooted in metacognitive and generative learning theories, these strategies have been shown to meaningfully boost cognitive performance. This supports the idea that when learners articulate and process their difficulties, as facilitated in the Magnified Math Solutions Strategy, they gain a better grasp of the subject matter.

Additionally, the findings are consistent with Kolb and Kolb's experiential learning theory, as cited by Silk et al. (2017), which emphasizes that learners gain a fuller understanding when they engage in reflective and activity-based tasks. Overall, the improvements observed in this study suggest that the combination of metacognitive engagement, personalized learning tasks, and responsive feedback played a significant role in enhancing students' academic outcomes.

Conclusion and Reflection

Based on the findings, it can be concluded that the Magnified Math Solutions Strategy is an effective intervention for improving the academic performance of learners in Statistics and Probability. This strategy not only enhanced students' achievement but also fostered the development of metacognitive skills, enabling them to reflect on and re-evaluate their own learning and better understand mathematical concepts through self-directed learning.

However, the study has limitations that should be considered. The small sample size (n=27) and the context being limited to modular distance learning during the post-pandemic period may affect the generalizability of the results. Additionally, external factors beyond the scope of the study may have influenced learner performance. Future improvements to the strategy could include testing its effectiveness in face-to-face classroom settings with larger and more diverse groups of students to validate and broaden its applicability.

Action Research Recommendations

Based on the foregoing findings and reflections, the following recommendations are presented:

1 Magnified Math Solutions Strategy should be implemented to other classes or schools which has the same CIGP in Statistics and Probability or in any subjects or discipline.
2 Results of the study should be disseminated to the teaching community for replication through LAC sessions and focused group discussions.
3 Similar further studies should be conducted to validate the findings of the study, have further improvement of the study and explore other strategies and interventions to improve learners' academic performance.

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