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Effect of Math Games to the Numeracy Skills of Selected Grade 1 Pupils in Multi-Grade Schools in Remote Area of Oras West District of DepEd-Eastern Samar Division

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Abstract

Aim: The study investigated the difference between the numeracy skills of grade 1 pupils in multi-grade classrooms in remote areas before and after the implementation of math games as intervention for the poor numeracy skills of the learners.

Methodology: This study utilized quantitative research approach and quasi-experimental design, specifically, one-group pretest-posttest design. The participants of the study were purposely selected grade 1 pupils from three (3) different multi-grade schools in Oras West District of DepEd-Eastern Samar Division. The research instrument used in this study was adopted pretest and posttest questionnaires named Rapid Mathematics Assessment (RMA) Toolkit for Grade 1, a standardized test developed by the University of the Philippines National Institute for Science and Mathematics Education Development and the Research Triangle Institute International under the ABC+: Advancing Basic Education in the Philippines program. Descriptive statistics such as frequency and percentage counts, mean, and standard deviation were utilized in describing the numeracy skills of the grade 1 pupils during the pretest and posttest. Meanwhile, inferential statistics such as t-test for dependent sample was utilized in investigating the significant difference between the numeracy skills of the learners before and after the implementation of math games.

Results: Results revealed that there was an improvement to the numeracy skills of grade 1 pupils following the implementation of the math games. This was supported by the statistically significant mean score increase of 10.8 points in their performance from pretest to posttest with $p<.0001$ which indicate that math games in a multi-grade classroom is highly effective in enhancing the numeracy skills among grade 1 pupils.

Conclusion: Math games significantly improved the numeracy skills of grade 1 pupils in multi-grade classrooms of Oras West District. It is recommended that the multi-grade teachers, together with the multi-grade schools, and curriculum developers to consider the integration of gamified instruction as a core strategy in early numeracy teaching.

Keywords: math games, gamified instruction, numeracy skills, multi-grade pupils

INTRODUCTION

Numeracy is a vital skill that individuals should learn while living in this fast-changing advance society. According to Reyna and Brainerd (2023), numeracy is the ability to understand and use mathematical concepts in everyday life, encompassing skills like reasoning, problem-solving, and critical thinking. It has become a crucial foundation in understanding the mathematical concepts embedded in every field of society, from agricultural to technological areas. In a global scale, numeracy has been viewed as a critical skill that serves as a foundation for lifelong learning. However, a lot of learners, particularly in remote areas, continue to struggle when it comes to basic numeracy skills. According to Bruine de Bruin and Slovic (2021), poor numeracy skill is more prevalent in countries with low income which potentially affect the financial well-being of its citizens. Meanwhile, Suryanti et al. (2020) argued that seventh grade students in Indonesia showed that 55% had low numeracy levels when dealing with higher order thinking questions. Furthermore, an analysis of 63 low- and middle-income countries revealed that 25% of children were suspected of developmental delay, with the literacy-numeracy domain being the most challenging. In addition,

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an analysis of 63 low- and middle-income countries found that 25% of children were suspected of developmental delay, with the literacy-numeracy domain being the most difficult. Significant inequalities were found in West and Central Africa, with 42% of children suspected of delay (Gil et al., 2020). Furthermore, a gap exists between mathematical literacy taught in schools and that assessed by international tests like PISA, with many students achieving only level 2 proficiency and scoring below the OECD average (Kusmaryono & Kusumaningsih, 2023).

Numeracy in a multi-grade classroom has much more pronounced issue than in a single grade classroom. Multigrade classrooms involve teaching students of different grade levels simultaneously, often arising from necessity in rural or resource-constrained settings (Işler, 2022). Comparatively, single-grade classrooms contain students of the same grade level, while multi-grade classrooms combine multiple grades into one class (Tastan & Bezci, 2023). In developing countries such as the Philippines, this problem also exists in the educational setting. The research on multi-grade classes in the City of Ilagan identifies that students demonstrate average performance in Mathematics, which calls for additional focused instructional time and differentiated instruction to enhance numeracy performance (Soriano, 2024). Furthermore, the inadequacy of instructional resources and inadequate professional development make it even harder for effective numeracy instruction in multi-grade classrooms (Medequillo & Gallardo, 2024; Naparan & Alinsug, 2020). These challenges necessitate targeted interventions such as enhanced teacher training and resource provision to support numeracy learning in multi-grade classrooms.

To address the prevailing issue, innovative teaching strategies are constantly being explored by educators. Current researches emphasize that mathematical games not only enhance learning outcomes but also address various learning needs and styles and are hence highly valuable in inclusive and multi-grade classrooms (Khaldi, Bouzidi, & Nader, 2023; Manzano-León et al., 2021). The use of game elements like points, badges, and leaderboards establishes an environment conducive to motivation that promotes perseverance and interest in mathematics. The success of math games is, however, reliant on effective implementation, such as adequate instructions and classroom organization, for facilitating equal access as well as long-term engagement (Khaldi et al., 2023; Manzano-León et al., 2021). Gamification makes learning in a traditional sense more enjoyable, encouraging students to participate more actively, cooperate, and exercise problem-solving abilities. For the purpose of numeracy skills, gamified learning assists by building an interactive environment where students learn mathematical concepts through play in a structured way, facilitating greater comprehension and retention. The challenging and rewarding environment of gamification stimulates persistence and motivation, thereby facilitating easier student success over challenges in numeracy. Duraiswamy and Mohammed (2024) investigated the impact of gamification on numeracy learning among primary school students in Tamil Nadu, finding that it significantly enhances numeracy skills and increases motivation and engagement. Similarly, Rodriguez and Cusme (2023) analyzed the use of gamification as a teaching strategy to improve understanding and motivation in learning application problems with rational numbers, finding that it significantly enhanced students' understanding, teamwork ability, satisfaction, and motivation for mathematics. Meanwhile, the study of Juwianthoa and Sidarta (2024) demonstrated the effectiveness of an interactive numeracy game in enhancing seventh-grade students' numeracy skills, particularly in data presentation, by creating an engaging learning environment and showing significant improvement in post-test scores compared to pre-test scores. The use of gamified learning in numeracy is also evidenced by research that indicates gamified platforms such as Kahoot increase student motivation and engagement, which are imperative for learning mathematics skills (Magallanes et al., 2024). Nevertheless, there needs to be explicit guidance, fair access to technology, and effective classroom management to maintain participation and optimize learning outcomes (Khaldi et al., 2023; Manzano-León et al., 2021). In fact, most of the existing studies have dealt with the effectiveness of math games in a single-grade or mono-grade classroom, and limited data exists showing the effectiveness of math games in a multi-grade classroom, particularly, in remote areas in the Philippines. In the context of Philippine education, a remote area refers to geographically isolated and disadvantaged locations where access to educational facilities, resources, and services is limited (DepEd, 2025).

This study sought to address this gap by investigating the effectiveness of math games on the numeracy skills of multi-grade learners in the remote areas of Oras West district of DepEd Eastern Samar Division. It is anchored on Constructivist Learning Theory, particularly the works of Jean Piaget and Lev Vygotsky. According to constructivism, learners actively build knowledge through experiences and interactions with their environment (Piaget, 1952). Math games, as interactive tools, allow learners to engage in discovery-based learning that supports cognitive development. Vygotsky (1978) emphasized the role of social interaction and the Zone of Proximal Development (ZPD), suggesting that learners can achieve higher levels of understanding with the help of guided tools or peers—which aligns with using structured math games in a collaborative classroom setup. These theoretical assumptions suggest that learners construct their numeracy skills through active engagement, gamified tasks serve as scaffolds that allow students to operate within their ZPD, improving performance, and socially interactive elements of games enhance mathematical

thinking in multigrade settings. In addition, the conceptual framework was developed based on research literature and relevant theories. It illustrates the presumed cause-and-effect relationship between the implementation of math games (independent variable) and numeracy skills (dependent variable). In spite of the geographical isolation of the research locale, the challenges faced by the multi-grade learners in the district represents the larger challenges faced by similar students in the remote areas in the Philippines. Thus, an urgent need to identify effective teaching strategies exist. By directing the study in this context, it aims to contribute for a localized and evidence-based intervention that can improve the teaching practices targeted in improving the numeracy skills of multi-grade learners in remote areas.

Objectives

This study investigated the difference between the numeracy skills of grade 1 pupils in multi-grade classrooms in remote areas before and after the implementation of math games.

Specifically, it sought to answer the following research questions:
1. What is the level of numeracy skills of the grade 1 pupils in the pretest?
2. What is the level of numeracy skills of the grade 1 pupils in the posttest?
3. Is there a significant difference between the numeracy skills of the grade 1 pupils during the pretest and posttest?

Hypothesis

Based on the objectives stated above, the following hypothesis was tested using 0.05 level of significance:
Ho: There is no significant difference between the numeracy skills of the grade 1 pupils during the pretest and posttest.

METHODS

Research Design

This study utilized quantitative research approach and quasi-experimental design, specifically, one-group pretest-posttest design. Quasi-experimental design is a research methodology used when randomization is not feasible, allowing researchers to estimate causal effects without full experimental control (Miller et al., 2020). Additionally, Marheni et al. (2021) defined one group pretest-posttest design as a research activity which offers a pre-test prior to being given a treatment, and after being treated then administers a post-test. This design was used in the study since it only involves a single group of grade 1 pupils limited by the number of learners in a multi-grade classroom. This group was subjected to math games as an intervention in improving their numeracy skills.

Population and Sampling

The study utilized purposive sampling technique in selecting the participants of the study. The participants of the study were grade 1 learners from three (3) different multi-grade schools in Oras West District of DepEd-Eastern Samar Division. The researchers adopted this arrangement because focusing on a single multi-grade school would result in a limited number of Grade 1 pupils participating, which could compromise the study's internal validity and lead to weak findings. With this, the researchers combined the number of learners of three (3) multi-grade schools in Oras West District. Eleven (11) grade 1 pupils were selected from Trinidad Elementary School, nine (9) from Bato Elementary School, and twelve (12) from Balingasag Elementary School, a total of thirty-two (32) grade 1 pupils in multi-grade classrooms. Moreover, the researchers made sure that the participants, despite coming from different schools, received the same intervention, attended with the same classroom set-up, and their teachers utilize the same teaching plan and approach.

Instrument

The research instrument used in this study were adopted pretest and posttest questionnaires named Rapid Mathematics Assessment (RMA) Toolkit for Grade 1, a standardized test developed by the University of the Philippines National Institute for Science and Mathematics Education Development (UP NISMED) and the Research Triangle Institute International under the ABC+: Advancing Basic Education in the Philippines Program 2021. The instrument was comprised of test items on different tasks namely, number identification and discrimination, fraction, addition, subtraction, geometric representation, missing shape in patterns, time measurement, and linear measurement with an overall maximum score of 35 points. The RMA Toolkit was used to evaluate the numeracy levels of the grade 1 pupils before and after the intervention was implemented. Specifically, the scores were interpreted using a scale: not proficient

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(below 25%), low proficient (26% to 49%), nearly proficient (50% to 74%), proficient (75% to 84%), and highly proficient (85% to 100%)

Data Collection

Prior to data gathering, the researchers secured the approval of school heads and teachers involved in the study. Afterwards, written consent was solicited from the parents for their permission to have their children as participants of the study. The researchers assured that the anonymity of the learners and the privacy of their data will remain throughout the study. After the permission and approval were granted, pretest was administered to the learners at the beginning of school year 2024-2025. Scores were recorded and the grade 1 pupils' level of numeracy skills were described. Math games as an intervention was implemented to the learners afterwards. Furthermore, the posttest was administered at the end of the school year and the scores were analyzed and interpreted in terms of their level of numeracy skills. Moreover, data gathered were stored and prepared for data analysis.

Treatment of Data

The study employed descriptive and inferential statistics in analyzing the data gathered from the participants. Descriptive and inferential statistics are two primary branches of statistics (Stapor, 2020). Descriptive statistics presents data in the form of tables, charts, and graphs, whereas inferential statistics makes conclusions regarding populations based on sample data (Stapor, 2020; Abdelfattah, 2021). Descriptive statistics such as frequency and percentage counts, mean, and standard deviation were utilized in describing the numeracy skills of the grade 1 pupils during the pretest and posttest. Meanwhile, inferential statistics such as t-test for dependent sample was utilized in investigating the significant difference between the numeracy skills of the learners before and after the implementation of math games.

Ethical Considerations

The researchers abide with the maximum ethical practices throughout the conduct of this study. Approval was sought from the school heads and teachers from participating schools, permission was sought from the parents through consent forms, anonymity of the partcipants was maintained, and the privacy of their data were secured.

RESULTS and DISCUSSION

Results revealed that there was an improvement to the numeracy skills of grade 1 pupils following the implementation of the math games. Prior to the intervention, 88%, comprising the majority of the pupils were identified to be "not proficient" or "low proficient" in the pretest, without any pupil reaching "highly proficient" level. After the implementation of math games, the posttest result showed improvement in the numeracy skill of the pupils, with 66% of pupils having "nearly proficient" to "highly proficient" levels. On the other hand, only 9% of the pupils remained in the "not proficient" category. This was supported by the statistically significant mean score increase of 10.8 points in their performance from pretest to posttest with $p<.0001$ which indicate that math games in a multi-grade classroom is highly effective in enhancing the numeracy skills among grade 1 pupils.

The mean score increase of 10.8 points between the pretest and posttest reflects a substantial improvement in the numeracy skills of Grade 1 pupils following the implementation of math games. This difference was found to be statistically significant, with a p-value of $< .0001$, indicating that the likelihood of this result occurring by chance is less than 0.01%. In quantitative research, such a low p-value provides strong evidence that the intervention—in this case, the use of math games—had a real and meaningful impact on learners' academic performance. The improvement in scores demonstrates that gamified learning activities effectively engaged learners, promoted concept retention, and provided opportunities for repeated practice in a playful, low-pressure environment. This aligns with constructivist learning theories, particularly Piaget's (1952) and Vygotsky's (1978) frameworks, which emphasize the importance of active, hands-on learning and social interaction in cognitive development. Math games, by their nature, provide immediate feedback, reinforce mathematical thinking, and encourage strategic reasoning, all of which are essential components of early numeracy development.

Numeracy Skills of Grade 1 Pupils during Pretest
The data in table 1 present the pretest scores of 32 Grade 1 pupils as measured by the Rapid Mathematics Assessment (RMA) Toolkit.

Table 1
Pretest Scores of Grade 1 Pupils in the Rapid Mathematics Assessment (RMA) Toolkit

Score Range in Percentage	Numeracy Level	F	%
85 to 100	Highly Proficient	0	0
75 to 84	Proficient	1	3
50 to 74	Nearly Proficient	3	9
26 to 49	Low Proficient	12	38
below 25	Not Proficient	16	50
Total		**32**	**100**
Mean		**11.04**	
Standard Deviation		**5.99**	

Most of the pupils (50%) were "not proficient" having scored 25% of the maximum pretest score. This group had a total of 16 pupils. In addition, 38% or 12 pupils were "low proficient" scoring between 26% to 49% of the maximum pretest score. Three (3) pupils (9%) fell on the "nearly proficient" level, scoring 50% to 74% of the maximum pretest score. Meanwhile, only one (1) pupil (3%) reached the "proficient" level, scoring 75% to 84% of the maximum pretest score, and none of the pupils achieved "highly proficient" level. The pretest performance of the grade 1 pupils had a mean score of 11.04 and a standard deviation of 5.99 which indicates that their average numeracy level was below the "low proficient" threshold with moderate variability.

This data suggests that a significant portion of grade 1 pupils entered the school year with very low foundations or numeracy skill as evidenced by the aforementioned data. Executive functions, language abilities, and attendance at kindergarten predict early numeracy ability, with executive functions specifically impacting the development of counting skills (Aunio et al., 2021). This result is vital for crafting and implementing effective numeracy interventions early in the school year. Interventions targeting early numeracy skills have positive effects, notably in numerical relational skill, although frequent and repeated interventions could be needed for sustained improvements (López-Pedersen et al., 2022; Aunio et al., 2021). The absence of highly proficient pupils emphasized the need for timely actions from multi-grade teachers. With this result, the parents should support numeracy development of their child even before formal schooling through everyday math activities such as counting objects, identifying numbers in the environment, and sorting and classifying household items.

Numeracy Skills of Grade 1 Pupils during Posttest
Table 2 presents the posttest scores of the same group of 32 Grade 1 pupils following the implementation of math games, as measured by the Rapid Mathematics Assessment (RMA) Toolkit.

Table 2
Posttest Scores of Grade 1 Pupils in the Rapid Mathematics Assessment (RMA) Toolkit

Score Range in Percentage	Numeracy Level	F	%
85 to 100	Highly Proficient	4	13
75 to 84	Proficient	9	28
50 to 74	Nearly Proficient	8	25
26 to 49	Low Proficient	8	25
below 25	Not Proficient	3	9
Total		**32**	**100**
Mean		**21.85**	
Standard Deviation		**7.46**	

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During the posttest 4 pupils (13%) scored "highly proficient" level, scoring 85% to 100% of the maximum posttest score. In addition, 9 pupils (28%) reached the "proficient" level scoring 75% to 84% of the maximum posttest score, while 8 pupils (25%) have "nearly proficient" level, scoring 50% to 74% of the maximum posttest score. On the other hand, another 8 pupils (25%) remained at the "low proficient" level, scoring 26% to 49% of the maximum posttest score, and the "low proficient" pupils decreased significantly to only 3 pupils (9%). Moreover, the mean score increased to 21.85, and the standard deviation rose slightly to 7.46, suggesting an upward shift with minimal increase in the dispersion of their scores.

These results show a significant improvement in the grade 1 pupil's numeracy level following the implementation of the math games. In comparison to the pretest, there is a decrease in the number of pupils with "not proficient" levels and an upward movement of the numeracy skills of the students into higher proficiency levels, which also includes the emergence of "highly proficient" and "proficient" pupils. This result further implies that the implementation of math games between pretest and posttest was effective in enhancing the numeracy skills of the grade 1 pupils. Gamified instruction has been found to have promising outcomes in enhancing numeracy and math performance at different grade levels. According to Malabayabas et al. (2024), research has shown that gamification increases student engagement, motivation, and comprehension of math concepts.

Test of Difference Between the Numeracy Skills of Grade 1 Pupils during Pretest and Posttest
Table 3 shows the statistical comparison between the pretest and posttest scores of Grade 1 pupils on the Rapid Mathematics Assessment (RMA) Toolkit.

Table 3
Difference Between the Pretest and Posttest Scores of Grade 1 Pupils

Tests	Mean Difference	t-value	p-value	Interpretation	Decision
Pretest vs. Posttest	-10.8	-10.6	<0.001	Significant	Reject the Null Hypothesis

Data analysis revealed a mean difference of -10.8 points, showing an average improvement of 10.8 points from pretest to posttest. This improvement has been found out to be statistically significant with a t-value of -10.6 and a p-value less than 0.0001, which is lesser than the conventional alpha level of 0.05. This leads to the rejection of the null hypothesis suggesting that the observed difference in scores are less likely to have occurred by chance and do reflects a genuine improvement in the grade 1 pupil's numeracy skills.

This result further confirmed that the implementation of math games brought positive effect on the numeracy skills of the grade 1 pupils in a multi-grade classroom. In addition, this finding was strongly supported by the large and statistically significant mean difference between the pretest and posttest performance of the grade 1 pupils. According to Magallanes, et al. (2024), the use of gamification approach is a powerful way to enhance the student engagement particularly when done with the right guidance, creating a positive a fun and learning environment. Moreover, gamified instruction has a positive effect on the self-efficacy of the students in mathematics (Bacsafra, 2024).

Conclusions
Math games significantly improved the numeracy skills of grade 1 pupils in multi-grade classrooms of Oras West District. Prior to this intervention, most of the pupils were classified as "not proficient" or "low proficient", indicating an alarming gap in their foundational numeracy. After the implementation of math games, there was a significant shift in their numeracy level, particularly, a number of pupils rose into higher proficiency levels. These include those with "proficient" and "highly proficient" levels. This improvement was further supported by a statistically validated data resulting to a p-value less than 0.001, confirming the effectiveness of the intervention.

Recommendations
Based on the aforementioned result, it is recommended that the multi-grade teachers, together with the multi-grade schools, and curriculum developers to consider the integration of gamified instruction as a core strategy in early numeracy teaching. For multi-grade teachers, this intervention or teaching strategy offers a practical way to allow learners to progress at their own pace while actively involved in the classroom. The multi-grade schools should provide support to the teachers by providing them with trainings and tools for effective utilization of gamified instruction. In addition, the curriculum developers should integrate the gamified elements into instructional materials ensuring that developing the learners' numeracy becomes enjoyable. Furthermore, the parents should support numeracy development of their child before formal schooling, especially in remote or resource-constrained areas. They may

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engage their child in simple, everyday math activities such as counting objects (e.g., fruits, utensils, toys), identifying numbers in the environment (e.g., house numbers, calendars), sorting and classifying household items by color, shape, or size. Moreover, the significant gains in the performance of the grade 1 pupils affirms that when learning is gamified and fun, they more likely engage meaningfully and achieve meaningful learning.

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