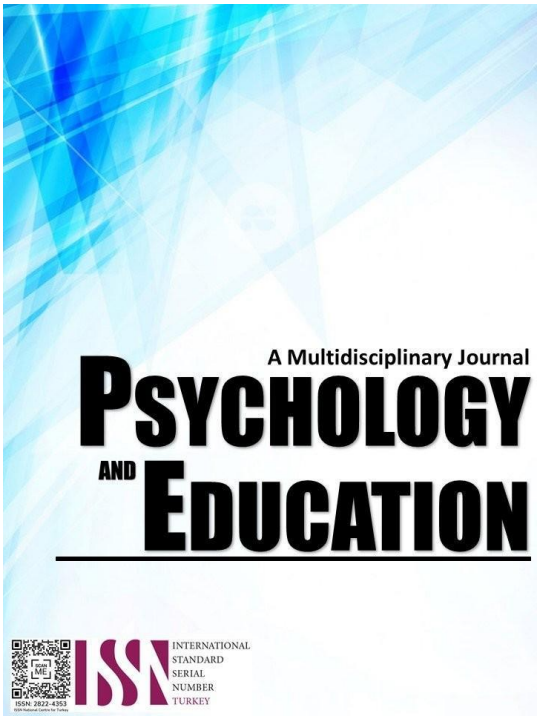
EFFECT OF SHORT NUMERACY VIDEOS ON STUDENTS' PERFORMANCE



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Research Article

Effect of Short Numeracy Videos on Students' Performance

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Abstract

This study aimed to investigate the effectiveness of using short numeracy videos in addition to the traditional use of flash card drills on students' numeracy skills, particularly the operations on integers. Using the quasi-experimental design, two sections of tenth graders of Himamaylan National High School, S.Y. 2023-2024, were involved in the study. The enhanced Regional Unified Numeracy Test was used to determine their performances. Both groups received their designated strategies for four weeks: the control group focusing on flashcards only, and the experimental group receiving short numeracy videos in addition to the flashcards. Results showed that the control group significantly improved their performance, although they remained at the nearly proficient level. The experimental group significantly improve their performance also, transitioning from the nearly proficient to the proficient level. When post-test scores of the groups were compared, it was found that the group that were introduced to videos significantly performed better. As such, it is recommended to use short numeracy videos in addition to the traditional flashcards drill to significantly impact students' numeracy skills.

Keywords: *numeracy intervention, operations on integers, short numeracy videos*

Introduction

The international community recently reported that Filipino secondary learners are behind in Mathematics, along with other core subjects, as reflected in the results of the Programme for International Student Assessment (PISA) (Balancio, 2023). According to Balancio's (2023) report, Filipino students scored significantly lower than the average scores of OECD countries. This educational challenge brings to light a persistent issue that demands urgent attention.

The importance of numeracy is widely acknowledged, with the State of Victoria's Department of Education and Training (2020) stressing that foundational skills are crucial to addressing the challenges in Mathematics education. Payton Guhl (2019) also emphasizes how strongly these numeracy skills influence success in mathematics, underscoring the vital role arithmetic plays in a student's mathematical journey. Yet, despite these assertions, there is a clear disconnect between the recognition of numeracy's importance and the realities of classroom performance.

In fact, a study by Mukunda Kshetree et al. (2022) found that students often lack a deep understanding of basic concepts like place value, properties of numbers, and how the different components of operations interact. This finding is all too familiar in the researcher's context in a secondary public institution in Himamaylan City, where baseline data from the current school year revealed that nearly 69.34% of tenth graders are struggling with basic operations on integers, despite these being a consistent focus of the Department of Education's efforts. This gap in student comprehension has become a growing concern and prompted the researcher to plan an intervention program anchored in Multimedia Learning Theory.

Mayer and Moreno's Cognitive Theory of Multimedia Learning, as cited in Jenlink (2019), suggests that combining text with visuals leads to better comprehension than text alone. Based on this, the researcher chose to use videos as a medium for the intervention. The effectiveness of video-based learning is supported by a study conducted by Mani Wangdi (2023), which found that learners exposed to videos showed a significant improvement in performance compared to those who were not. However, while these studies demonstrate the benefits of videos, they are typically applied to mandated curricular content, leaving a gap when it comes to their use in improving foundational skills like numeracy. This represents a crucial area for further research and exploration.

With all these, the researcher, being an educator, conducted a study using videos to assess whether the performance of learners in performing operations on integers can be improved.

Research Questions

The researcher investigated the effectiveness of short numeracy videos of Grade 10 learners in Himamaylan National High School, Division of Himamaylan City (S.Y. 2023-2024) on the performance on the fundamental operations. Specifically, the researcher answered the following questions:

1. What are the pretest and post-test performances of the group without short numeracy videos?
2. What are the pretest and post-test performances of the group that has short numeracy videos?
3. Is there a significant difference between the pretest and post-test performances of the group without short numeracy videos?
4. Is there a significant difference between the pretest and post-test performances of the group that has short numeracy videos?
5. Is there a significant difference between the post-test performances of the two groups?

Literature Review

Numeracy Performance

Numeracy performance in the Department of Education is regarded as an important indicator of learning, given that the current direction of Philippine education is geared towards honing the foundational skills that were not fully addressed by educational setbacks.

For years, a pair of researchers: Takiko Igarashi and Daniel Suryadarma, studied the mastery of foundational skills of fourth graders to tenth graders in mathematics and reading. Igarashi and Suryadarma (2023) found a continuous drop in the foundational skills of learners in Mathematics. This meant that the quality of learning the basic skills in Mathematics—which include fundamental operations—decreased. Igarashi and Suryadarma (2023) further claimed that some secondary students failed to master third-grade skills.

Another descriptive study which was conducted by Raymundo Santos et al. (2022) investigated secondary public school learners in the Philippines. The finding of the study is that learners have poor competency levels. Difficulties in the various aspects of number sense emerged; obviously including operations on numbers.

Edmar Indefenso and Alberto Yazon (2020) also affirmed the importance of learning numeracy, from an educational perspective. Employing a correlational research design, the study was conducted on 563 high school students in the Philippines. Indefenso and Yazon (2020) found that numeracy is positively correlated to problem-solving. This means that problem-solving skills increase with numeracy skills. This paper sheds light on the need to focus on foundational skills if the country intends to improve its PISA performance, where problem-solving skills are assessed.

One study was found by the researcher that detailed errors in numeracy tests. Madihad Khalid and Zulmaryan Embong (2020) observed high school students as they dealt with the operations of integers. The errors they found were carelessness, inability to perform multiplication and division, and too much getting used to whole numbers.

In a technical sense, numeracy performances are assessed by numeracy assessments. Robert Williams (2023) stated that these are tools that measure one's ability to work with numbers. Arithmetic is one component of such an assessment. In the context of this research, the numeracy test observed by all schools is the enhanced Unified Regional Numeracy Test (DepEd Region VI, 2022).

Such an instrument was crafted and validated by the DepEd Region VI office and composed of 40 items: 10 items for addition, 10 items for subtraction, 10 items for multiplication, and 10 items for division. These items focus on integers from -10 to 10. Scores are interpreted as highly proficient, proficient, nearly proficient, low proficient, or not proficient.

Integration of Videos in Teaching and Learning

Concerning technology and education, McGraw Hill (2019) discussed the assumptions of Mayer and Moreno's Cognitive Theory of Multimedia Learning in his work. The theory implies that by using video lessons, students are provided with a representation of learning that can stimulate memory that can't be done by the non-usage of such.

Ceken (2022) examined the application of said theory across various learning environments. The implementation of the principles anchored to this theory, as Ceken (2022) claimed, enhanced learning outcomes. The same article declared that modality was the most studied multimedia learning principle, as in the case of this paper, the use of videos in addition to flash cards.

Cavanagh and Kiersch (2023) declared that the said theory focuses on active processing assumption, limited capacity assumption, and dual-channel assumption. This balance can be effectively captured in a well-structured video where the verbal information focuses on narration or voice while the non-verbal information on the animation or graphics.

A series of papers analyzed by Michael Carmichael, Abigail-Kate Reid, and Jeffrey Karpicke (2018) affirmed the previously stated assumptions. Consistently, Carmichael et al. (2018) reported that students in surveys and interviews, declared that videos improve their learning in different ways: comprehension, retention, provision of alternative perspectives, interest/motivation, and knowledge expansion. Experimental research also found that students with access to video materials performed significantly better than control groups (Carmichael et al., 2018).

Yip et al. (2019), in their paper, found that the use of videos offered a better transfer of basic knowledge and skills to learners. This also reduces the time and effort to absorb learning information. Aside from these, videos give the learners the flexibility to review or revisit the contents covered in class.

Van Alten et al. (2020) in their study on 115 students in the secondary level found a positive effect on the use of video lessons on students' learning outcomes. This is consistent with the findings of the previously discussed researchers.

An interesting finding was discovered by Noetel et al. (2021) in their systematic review of papers that investigated the use of videos in teaching and learning. A total replacement of usual teaching-learning strategies with a video lesson improved student learning at a small scale only. However, combining video lessons with the usual teaching-learning strategies of a teacher led to higher impacts on student learning. This supported the researcher's use of videos on top of the usual teaching-learning process. The researcher still used the drills on flashcards and complemented them with videos.

The next area to be looked into was the length of the videos to be used. This question was connected to the article by Shank (2022). The research suggests that videos shorter than six minutes are considered optimal for learners as videos longer than this would result in reduced viewer engagement.

Using Videos in Numeracy

Though there is literature on the integration of videos in teaching and learning, few studies in the recent decade specified its utilization on numeracy or mathematical content. Most studies still focus on the use of flashcards. For instance, the study of Chong et al. (2022) declared that the cards were helpful in the teaching and learning of integral operations.

This is the already existing intervention employed by the researcher in her classes. The plan with the paper was to add videos on top of this strategy.

Wei et al. (2020) used videos to improve the learning of Chinese learners in middle-grade mathematics. Eighty-eight students participated in the study which were grouped into experimental and control groups. The experimental group, based on the findings, significantly showed improvement in their learning performance.

Kullberg et al. (2024) used videos in teaching numeracy, particularly operations on fractions. Although the study focused on fractions and this paper on integers, this was still considered relevant as both fall under the strand of Numbers and Number Sense. In their study, the experimental design was also used. The intervention or experimental group was reported to show a higher mastery, manifesting in solving tasks involving higher quantities.

At Sonamthang Lower Secondary School, video clips were also used by researcher Mani Wangdi (2023) to enhance the numeracy achievement of learners, particularly in the eighth grade. An experimental pretest-post-test design was employed. Differences in the pretest and post-test scores were considered. Pretest differences were not significant indicating that the control and experimental group were statistically the same in their numeracy performance before the intervention. Post-test differences were found to be significant, with the experimental group having a higher level of performance. Wangdi (2023) analyzed students' opinions also and reported that students preferred using video clips in learning numeracy.

As the world continues to accept more social media platforms, a paper by Uswatun Hasanah and Heni Pujiastuti (2022) investigated the integration of TikTok in Mathematics learning. Findings showed that most students use TikTok and that they perceive the platform to be beneficial in learning Mathematics. This propelled the researcher to consider videos on YouTube that may be TikTok material, that are less than six minutes.

Methodology

Research Design

In this study, the researcher utilized quasi-experimental design, with the pretest-post-test measure. Stratton (2019) wrote that this experimental design intends to examine a dependent variable (in this paper's case, the performance of learners on the fundamental operations on integers) before and after the integration of an independent variable (in this paper, the grouping for intervention).

Respondents

The study's participants were the learners of the tenth grade attending a public secondary school, as the paper is targeted at addressing the gap in the secondary education system. The public secondary school was in the Schools Division of Himamaylan City for S.Y. 2023-2024. The participants were categorized into two distinct groups to facilitate a comparative analysis of the intervention's impact: an experimental group and a control group.

To ensure uniformity of data, the number of participants in both groups was made equal. Groups were identified through cluster sampling. Frost (2021) defines cluster sampling as a technique of taking groups as samples. Clusters have to be naturally occurring; as such, the identical, heterogeneous sectioning of the Grade 10 class was considered. This was to ensure that each group reflects the population, as suggested by Frost (2021).

Sections were placed in a bowl and two were drawn to serve as the experimental and control groups. The sections identified have 38 identified participants.

Instrument

The data gathering instrument was the DepEd Region VI's Enhanced Regional Unified Numeracy Test (e-RUNT). This was the standard tool used by all DepEd schools in Region VI to determine the numeracy performances of learners.

The instrument was accomplished through a pen and paper test. It contains 40 items in total. Ten items are allotted for each of the four operations on integers: addition, subtraction, multiplication, and division. This instrument was administered for ten minutes only.

To ensure further validity, three Mathematics experts with master's degrees evaluated the tool using the Content Validity Ratio (CVR), which resulted in a perfect score of 1.00, confirming its strong validity.For reliability, data from a different class underwent KR20

analysis, yielding an index of 0.902, indicating excellent reliability. Additionally, the videos used in the study were assessed by the same experts using the Department of Education's Learning Resource Rapid Assessment Tool. The materials received a quality assurance index of 90.48, signifying their high quality and acceptability.

Procedure

The researcher first obtained permission from the principal or school head to conduct the study. Then, the intervention matrix was reviewed by three Mathematics experts for quality assurance. Validity and reliability tests were also performed on the e-RUNT. The sampling technique was then employed. Once the sample classes were determined, parental consent and assent were secured. The intervention was done in a span of four weeks.

It followed three phases: pre-intervention, intervention, and post-intervention. Before the intervention, both groups took a pretest, and statistical analysis confirmed no significant difference in their initial performance, validating their eligibility for the study. Participants were then randomly assigned as either the experimental or control group. During the intervention, both groups engaged in 10-minute numeracy drills before their regular lessons. The control group used only flashcards, while the experimental group watched videos in addition to flashcards. One week was allotted to each of the four operations.

Data Analysis

Mean was used to describe the pretest and post-test performances of the learners. The performances were interpreted as: 36-40 (highly proficient); 30-35 (proficient); 20-29 (nearly proficient); 10-19 (low proficiency); and 0-9 (not proficient). Pretest and post-test scores within groups were tested for difference using the Wilcoxon signed-rank test, while the post-test scores between groups were analyzed using the Mann-Whitney U test.

Ethical Considerations

Permissions were secured prior to the conduct of the study. The information of the participants were kept confidential and the accomplished instruments were kept safe until these were validated by the institution, when they were then deleted.

Results and Discussion

Numeracy Performance of the Control Group

Based on the e-RUNT results, the students have higher scores in the post-test (Mean = 25.50) than their scores in the pretest (Mean = 19.24). Despite the increase, however, when interpreted based on DepEd standards, the group remained in the nearly proficient group.

Table 1. *Pretest and Post-test Scores of the Control Group*

Type of Assessment	*n*	*Mean*	*Interpretation*
Pretest	38	19.24	Nearly Proficient
Post-test	38	25.50	Nearly Proficient

Computed Value (Z) = -4.31
p-value : <.001
Decision: Reject H_0
Interpretation: Significant at 0.05 level of significance

Statistical test revealed that the post-test scores were significantly higher than the pretest scores, Z = -4.31, p < .001, as shown in Table 6. This means that the traditional strategy of using flashcards can significantly improve learner performance on numeracy.

Numeracy Performance of the Experimental Group

The post-test scores of the experimental group were higher (Mean = 31.34) than the pretest scores (Mean = 19.16). Based on these descriptive statistics, before the intervention, the students were on the nearly proficient level, meaning they demonstrated basic understanding but made occasional numeracy errors. After the intervention, they belonged to the proficient level, meaning they demonstrated solid and reliable numeracy skills.

Table 2. *Pretest and Post-test Scores of the Experimental Group*

Type of Assessment	*n*	*Mean*	*Interpretation*
Pretest	38	19.16	Nearly Proficient
Post-test	38	31.34	Proficient

Computed Value (Z) = -5.36
p-value : <.001
Decision: Reject H_0
Interpretation: Significant at 0.05 level of significance

Wilcoxon signed-rank test revealed that the post-test scores of the learners are significantly higher than the pretest scores, Z = -5.36, p < .001. This means that the use of the videos in addition to the drills significantly improved learner performance in numeracy.

Numeracy Posttest Performances of the Two Groups

Given that both the strategies of using flashcards only and using videos in addition to flashcards significantly improved learner

performance, the post-test scores of the two groups were compared.

Table 3. *Pretest and Post-test Scores of the Experimental Group*

Type of Assessment	*n*	*Mean*	*Interpretation*
Post-test (Control)	38	25.50	Nearly Proficient
Post-test (Experimental)	38	31.34	Proficient

Computed Value (U) = 335.50
p-value : <.001
Decision: Reject H_0
Interpretation: Significant at 0.05 level of significance

Mann-Whitney U test revealed that the experimental group (the one with videos) has a significantly higher post-test performance than the control group (the one without videos), $U = 335.50$, $p < .001$. This means that even though the two types of strategies did improve student performance, it was the strategy that used the short numeracy videos that greatly increased numeracy scores.

For both the pretest and post-test, the group without the videos demonstrated basic understanding but made occasional errors in numeracy. This means that the students showed that they understood the basic concepts but struggled with some applications. Statistics further implied that existing strategies involving flashcards could indeed help learners. This supports the findings of Chong et al. (2022). In the article of Chong et al. (2022), it was discussed that using flashcards can improve student learning outcomes. This is similar to the results of the inferential statistics in the pretest and post-test scores of the control group. As stated, this strategy similar to the context of Chong et al. (2022) can be beneficial to learners struggling with their numeracy skills.

For the experimental group, the students transitioned from understanding the basic concepts with struggles in applications to showing a strong understanding, and capability of working independently. Statistics further revealed that using videos in teaching numeracy is beneficial to learners. This is consistent with the findings of Carmichael et al. (2018), Yip et al. (2019), and van Alten et al. (2020) claiming that videos benefit student learning outcomes. These studies claimed that videos improve retention and comprehension, reduce time and effort to absorb learning as compared to the traditional methods, and thus, have a positive effect on learning numeracy. The statistics showed the same in the context of the learners involved in this paper.

Further comparisons between the two groups showed that when made to choose between using flashcards only and using flashcards with videos, the strategy with the short numeracy videos must be highly considered. This is consistent with the finding of Noetel et al. (2021) that merging a traditional strategy with videos would highly impact student learning. This means that for teachers to significantly improve their learners' numeracy, they have to blend traditional flashcards with the use of video materials.

The stronger performance of the group with short numeracy videos suggests that incorporating videos into classroom practice can provide a measurable advantage. Because of this, to capitalize on the success of the short numeracy videos, it is recommended to integrate more multimedia resources into regular instruction. This approach has shown to be particularly effective in improving numeracy skills.

Conclusions

Based on the results, the group of tenth graders without the short numeracy videos remained at a level wherein they had a basic understanding of the concepts of the operations on integers and would require further assistance. The group of tenth graders with the short numeracy videos moved from an understanding of the basic concepts to a strong understanding, capable of working independently.

Even with the flashcards only and without the short numeracy videos, numerically speaking, the students' performance in numeracy improved, affirming the claim of Chong et al. (2022) that flashcards impact the numeracy skills of students. It is to be noted, however, that while the performance improved the students remained in the same proficiency group. The short numeracy videos improved the students' performance in numeracy. Though both performances improved with or without the short numeracy videos, the group that received the short numeracy videos showed higher performance than the group that did not.

Overall, these affirm the Theory of Multimedia Learning discussed by McGraw Hill (2019), stating that adding videos as another form of medium in instruction could improve student learning of knowledge and skills.

As explained by Cavanagh and Kiersch (2023), the Cognitive Theory of Multimedia Learning is built on three key ideas: active processing, limited capacity, and dual channels. These stress the importance of balancing verbal (spoken) and non-verbal (visual) information, as done by the video lessons. By following the suggestion of Shank (2022) that videos shorter than six minutes are considered optimal for learners as videos longer than this would result in reduced viewer engagement, the limited cognitive capacity assumed by the Multimedia Learning was also targeted.

Future numeracy programs should prioritize multimedia tools to maximize student outcomes. Teachers can create contextualized less-than-6-minutes video lessons for use. It is suggested that future research explore other dimensions related to this study that were not covered in the current paper. Expanding the research to include a broader range of participants across different grade levels would provide more comprehensive insights. Additionally, investigating various strategies to address numeracy gaps is recommended to generate evidence-based solutions that can enhance student learning outcomes.

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