



Applied Research and Innovation (ARI)

ISSN: 2993-8988 (ONLINE)

VOLUME 4 ISSUE 2 (2026)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Improving Numeracy Skills, Achievement, and Attitude Towards Mathematics Using Sugary Math Adventure Worksheet

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Article Information

Received: June 26, 2026

Accepted: September 05, 2026

Published: September 23, 2026

Keywords

Achievement Math, Attitude Towards Math, Math Worksheet, Numeracy Skills, Sugary Math Adventure

ABSTRACT

Struggles in mathematics are commonly observed in the learning education of Filipino children. This problem affects the learners' motivation to engage in classroom activities. This study was conducted with the 25 Grade 1 students from one public school in Muntinlupa City, Philippines. It aims to evaluate the developed Sugary Math Adventure worksheets, a gamified worksheet to enhance learner numeracy skills, improve classroom performance, and promote positive behavior changes towards the mathematics subject. This research utilized the mixed method; the quantitative approach involved pretest and post-test assessment to measure students' numeracy skills, while the qualitative approach gathered reflections to check changes in attitude and engagement. This worksheet was structured based on Grade 1 competencies, featuring bilingual instruction and interactive activities inspired by the mobile game, Candy Crush. These data are carefully analyzed to guarantee the transparency of the worksheet's effectiveness on the students' achievements. The results of the study revealed that students who used worksheets showed significant improvement in numerical skills. It also shows the positive development of the children towards classroom engagement, showing more interest and motivation after using the worksheet. Also, it highlights the importance of interactive learning worksheets in the early stages of education in mathematics. The Sugary Math Adventure worksheet made a great impact on improving the children's numeracy skills, academic achievement, and attitude towards mathematics.

INTRODUCTION

Numeracy skills build the fundamentals of success in academics and eventually in solving problems in real-life situations. In the article in Sun Star Pampanga published by Gigante (2020), numeracy is one of the fundamental skills that a learner must develop and master at an early age. Fundamental mathematics plays a vital role in developing the numeracy skills of the learner. Pushing the learner to improve these skills leads them to experience difficulties, causing negative thoughts and discouragement. Some of them complain that math is too hard and dull. This struggle is a common case in elementary education in the Philippines. Mathematics is a subject that many learners either love or hate. This study will create a smart method of teaching with more student involvement and foster a positive mindset toward mathematics education. Education research studies have stressed that an effective teaching approach that boasts learning outcomes in mathematics is the use of proper tools. According to Cantonjo and Janer (2022), learning activity sheets were proven effective in enhancing the problem-solving skills of the students. Worksheets find their place in every educational toolbox, which contributes by offering students consistent learning support. This interactive worksheet is composed of a platform of questions and answers so that learners can attain confidence in understanding the subject matter. Based on the case study of Munifah *et al.* (2019), the worksheets could result in a tremendous improvement in students' numeracy skills, along with their attitude and

feelings towards mathematics. According to the study of Novitasari *et al.* (2022), these devices enable students to apply what they have been taught and enhance their critical thinking skills, problem-solving, and evaluation methods.

Literature evidence has shown that well-created worksheets have improved students' levels of understanding and retention of math concepts. An effective mathematics worksheet conveys suitable learning experiences and structured ways to achieve mastery of mathematics. In the journal research of Celik *et al.* (2021), students who had activity sheets to study for mathematics improved in solving math problems. Hence, the application of different types of representation-based worksheets has a positive influence on the skills of the learners. Also, other multimedia tools have been discovered to have positive effects on learners' approach to the subject matter.

References to studies can tell us about the strong connection between students' attitudes toward mathematics and their grades in the subject. Unfortunately, a considerable number of students think that mathematics is something to be afraid of and to be detested. This leads to devastating effects on both their performance and their interests. According to the statement of the American Association of Mathematics Teachers (2020), for instance, interventions designed to promote beneficial mindsets have been proven to be associated with improved student outcomes and higher subject engagement. Using the elements that can make the learning setup less intimidating yet enjoyable,

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mathematical worksheets will play an indispensable role in creating a culture of young learners.

Although worksheets are proven to help people learn, they teach differently from the traditional way of learning and other instructional materials, like in the study of Nurhidayah et. al. (2020), students who use the worksheet find it more useful and have a positive effect on their achievement performance. Despite that evidence, only a few researchers conduct a study about the effectiveness of math worksheets at the primary grade level, specifically at the primary level. Many educators and even parents are having a hard time searching for meaningful resources that are research-based and developmentally appropriate, that can help the primary students as they continue to engage in a variety of learning tasks. This disparity proves the necessity of research-based, developmentally friendly educational materials for effective learning methods for young learners. This study aims to bridge what is currently considered to be this gap.

Based on these points, the main goal of this study is to develop a math worksheet for Grade 1 students designed to improve their numeracy skills, achievement, and attitude towards the mathematics subject. The Sugary Math Adventure worksheet was evaluated by mathematics content experts to make sure it is effective and appropriate for the learners. To know the effectiveness of the worksheets, a posttest and a pretest were conducted, and the outcome scores were analyzed. Additionally, to assess the students' attitudes, self-reflection will be given in the last part of the worksheet. This goal is to develop a practical and well-supported tool that enhances early math education.

LITERATURE REVIEW

Worksheet and Numeracy Skills

Numeracy Skills are essential in everyday life, problem-solving and academic success. Many studies emphasize the importance of worksheets in enhancing these skills. According to Cantojo and Janer (2020), learning activity sheets is significantly effective in enhancing the problem-solving skills of the students and confidence in Math. Similarly, Celik *et al.* (2021) found that the use of worksheets improved students' retention in math concepts and comprehension. Nurhidayah *et al.* (2020) highlight that worksheets promote mastery and scaffolding in basic math concepts.

Gamification and Student Engagement

Gamified instructional materials have been proven to increase students' motivation and engagement. Novitasari *et al.* (2022) study showed that interactive and game-inspired worksheets enhance critical thinking and intensify numeracy understanding by making the lesson fun. Munifah *et al.* (2019) also proved that integrating interactive worksheets improved not only the numeracy performance of the students but also the students' attitude towards mathematics. These outcomes support the Sugary Math Adventure worksheet, which was

inspired by the mobile game Candy Crush to create a fun and interactive worksheet.

Attitude Towards Mathematics

Students' perceptions of mathematics have a big impact on their academic performance. Hwang and Son (2021) discussed that having a positive attitude can lead to a higher level of achievement in Math, while a negative attitude can prevent students from performing well in a particular subject. Similarly, the American Association of Mathematics Teachers (2020) highlights that interventions designed to make a valuable mindset are connected with improved engagement and learning outcomes. Paguican and Torreón (2020) also described that self-confidence and motivation are essential in shaping mathematics performance among learners.

Research Gap and Rationale

Even some studies have shown worksheets are effective in enhancing students' academic performance in Mathematics, based to Monding & Buniel, 2021, and Hofileña & Bearneza, 2023, few numbers of research have focused on developmentally appropriate, gamified worksheets for lower grade levels. Most of the existing studies are focused on a higher grade level or in different contexts, creating a gap in resources for Grade 1 Students. To address the gap, the Sugary Math Adventure Worksheet was developed to enhance the numeracy skills, achievement, and attitude towards mathematics for young Filipino learners, while making math less intimidating and more fun.

MATERIALS AND METHODS

Research Design

The research utilized a one-group pre-test and post-test experimental design study to assess the impact of the Sugary Math Adventure worksheet on the students' numeracy skills, achievement, and classroom behavior towards mathematics among Grade 1 students in a Public School in Muntinlupa City. The worksheet covered only the first and second quarters of the school year 2024-2025. The worksheet contained fun and engaging activities that would help the students understand the fundamental operations in mathematics. The worksheet covered addition without regrouping, subtraction without regrouping, skip counting, and basic division. The final part of the worksheet contained statements regarding student satisfaction with the worksheet, which are answerable by agreeing or disagreeing. The researcher used a quantitative approach to provide accurate results to measure students' numerical intelligence using pre-tests and post-tests. The result of this test was subjected to comparison to define the student's improvement in fundamental mathematics statistically. In the first quarter, the students answered the first pretest assessment covering addition without regrouping and subtraction without regrouping, then the Sugary Math Adventure worksheet for addition and subtraction was implemented

and added as a part of the learning instructional material. Then, the first post-test was administered covering the same topic that students had covered in the first quarter pretest assessment. In the second quarter, the student answered the second pretest assessment, which covers skip counting and basic division. After the pretest

assessment, the Sugary Math Adventure worksheet for skip counting and division was implemented and added as part of the instructional learning material. Finally, the second post-test was administered imposed, covering the same topic that students took on the second quarter pretest assessment.

Table 1: Time allotted to integrate the intervention, Sugary Math, in instructional hours

Topics	Pretest	Intervention	Post-test	Satisfaction Towards worksheet
1st Quarter Addition without regrouping, subtraction without regrouping	30 minutes	360 minutes (45 minutes per week for a total of 8 weeks)	30 minutes	10 minutes
2nd Quarter skip counting and basic division	30 minutes	360 minutes (45 minutes per week for a total of 8 weeks)	30 minutes	10 minutes

Also, the researcher used a qualitative approach for the transparency of the study, using students' achievement and reflection. At the end of the worksheet, the student answers statements to express their feelings towards the worksheet. Then, the researcher collects the results of the student's reflection on the worksheet to gauge their behavior, like interest and motivation in mathematics. The students' first and second quarter grades in mathematics are collected and studied statistically to determine the effect of the worksheet on student achievement. This result supports the researcher's study on the effectiveness of the Sugary Math Adventure worksheet as a learning instructional material.

Material Development

The Sugary Math Adventure worksheet is based on competencies for Grade 1. The worksheet includes an interactive game inspired by the popular game Candy Crush. It consists of multiple levels that focus on different lessons. To proceed to the next level, students must answer all the activities correctly to ensure mastery of the lesson. It also contains explanations and examples for each topic that allow the students to work independently. The Sugary Math Adventure worksheet mode of instruction is bilingual, using Tagalog and English, to include the diversity of students for proper and better comprehension of the task and activities



Figure 1: Sugary Math Adventure Worksheet

inside the worksheet. The worksheet is structured into four progressive levels. The first level contains basic math operations in addition for numbers without regrouping. This level also provides step-by-step instructions on how to answer math problems. The second level contains

math operations in subtraction without regrouping. This level also provides step-by-step instructions on how to answer the activity with sample exercises. On the third level, the worksheet covers skip counting. It also provides sample exercises that the students can follow

to understand more about the topic. On the last level, the worksheet will cover mathematical operations in division. This level also contains sample practices with explanations to provide students with simple patterns to follow. The Sugary Math Adventure worksheet is inspired by an entertaining mobile game called Candy Crush. The worksheet contains engaging visual elements and Candy Crush characters like Mr. Toffee and Tiffi. These characters give instructions to the students in each level to make the worksheet interactive and engaging. Familiarity with colors is also applied in the worksheet since some instructions in other levels contain specific colors to deal with. The tiles are composed of colorful candies along with the math equation they need to solve. The worksheet also provides instructions to color the levels they finished on the roadmap.

Participants of the study

The participants of the study are consists of 25 Grade 1 students from the public school of Bayanan Muntinlupa City, Philippines. Class advisor was also included as a participant of the study since the researcher also included student achievement of the selected participants.

Research Instruments

The study used pre-test and post-test assessment exams to gauge students' numeracy skills, achievement, and attitude toward mathematics. The assessment tool is made up of four fundamental math operations and has 25 items to evaluate the student's numeracy skills. The Sugary Math Adventure worksheet, built to enhance their math skills, is composed of four levels. Each level has 12 items focusing on different fundamental math operations. Level 1 is an addition, which enhances students' ability to combine numbers with or without regroupings and develop their basic addition skills. Level 2 is a subtraction operation, which develops the students' knowledge in removing numbers and cultivates their understanding of basic subtraction concepts. Skip counting is level 3, which is designed to introduce the basic multiplication concept to the students at the primary level. It strengthens their number sense and counting fluency by twos, fives, and tens. Lastly, level 4 is a division operation that develops students' basic understanding of equal sharing and regrouping. The Sugary Math Adventure worksheet was also evaluated by math coordinators and a grade 1 teacher for content validity, effectiveness, and appropriateness.

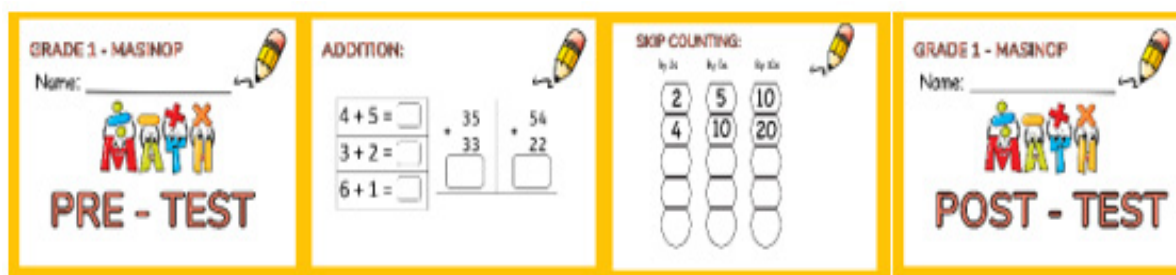


Figure 2: Pretest/Post Test Assessment Exam

Data Gathering Procedure

The researcher conducts a pretest assessment exam to measure the initial numeracy skills of the participants. Then, the researcher implements the use of the Sugary Math Adventure worksheet as an individual activity. This activity was supervised and monitored by the researcher. Before completing every level, the student consulted the researcher about their answered worksheet. The researcher will only allow the student to go to the next level if all the required problems have been solved correctly. If not, the student can redo the level until he/she gets the correct answer. This

is to ensure the mastery of the lesson. After all the levels are completed by all participants, the researcher conducts a post-test assessment to assess the effectiveness of the worksheet. The advisor evaluated the achievement of the participants as well as their attitude towards mathematics.

RESULTS AND DISCUSSION

Objective 1: To assess the effectiveness of the Sugary Math Adventure Worksheet, the researcher compares the pre-test and post-test scores of the students as shown in Table 2.

Table 2: Pre-test Vs Post Test Score

Skills	N	Mean Scores			F-value	p-value	Remarks
		Mean-Pre-Test	Mean-post-test	Mean Difference			
Addition	25	4.64 (low)	9.32 (high)	4.68	8.12	<0.001	Significant
Subtraction	25	3.12 (low)	9.68 (high)	6.56	9.45	<0.001	Significant
Skip counting	25	3.12 (low)	8.76 (high)	5.64	8.97	<0.001	Significant
Division	25	0.00 (low)	5.84 (Average)	5.84	11.21	<0.001	Significant

Based on the table 2, all students have low fundamental knowledge in mathematics, as reflected in their pretest scores. After implementing the Sugary Math Adventure Worksheet with the students, they built up basic knowledge in mathematics and were able to increase their score as shown in their post-test results. The mean difference ranges from 4.68 to 6.56 led to the remark of significant difference using F-test and further described using the p-values ($p < 0.001$) indicating that the improvements in all skills are statistically significant. The Sugary Math Adventure Intervention has improved learner mathematical skills encompassing the four fundamental operations. The result of the study

contributes to the fund of knowledge and teaching practices in mathematics that math skills can be improved using intervention materials that are carefully and contextually designed by the teachers based on the needs and interest of the students. This finding is supported by Munifah *et al.* (2019), who revealed that the use of interactive worksheets led to a great improvement in students' numeracy skills and positively influenced their attitude toward mathematics.

Objective 2: To measure the development of students in Mathematics, the researcher records the quarterly grade of all students in Mathematics of the current school year as shown in Table 2.

Table 3: Quarterly Grade Achievement in Mathematics

Grading Period	N	Mean Score	SD	Mean difference	t-value	p-value	Remarks
1st Grading	25	78.24	4.35	+3.16	9.43	0.03	Significant
2nd Grading	25	81.40	4.12				

The table 3 indicates a noticeable improvement in students' Mathematics grades from the first to the second grading period, showing the worksheet's positive impact on their academic performance. This result is consistent with Nurhidayah *et al.* (2020), who found that the implementation of worksheets significantly enhanced students' mathematics learning outcomes,

resulting in improved academic achievement.

Objective 3: To determine the number of students who have positive and negative impacts towards the Sugary Math Adventure Worksheet and Mathematics itself, the researcher used the Likert Scale to determine their feelings, as shown in Table 3.

Table 4 above shows that the majority of students had

Table 4: Short responses of Grade 1 students regarding the Sugary Math Adventure Worksheet.

Statement	N	Agree (%)	Disagree (%)
I have fun answering the worksheet.	25	100%	0
I am excited to solve the Math problems in the worksheet.	25	100%	0
I felt that the questions in the worksheet are easy.	23	92%	8%
I felt proud after finishing all the levels in the worksheet.	25	100%	0
I love now learning Math after finishing the worksheet.	25	100%	0

fun and felt excited answering the worksheet. A total of twenty-three students felt that the questions inside the worksheet were easy. Four statements were tied with the highest rank (1.5) due to perfect agreement, while one statement ranked lower (5) due to slightly lower agreement (92%). Finally, all of the students felt proud after finishing the level in the worksheet and are now in love with learning mathematics. This outcome is supported by Cantonjo and Janer (2022), who emphasized that learning activity sheets increase student motivation and enjoyment, making math lessons more interactive and less intimidating.

This research positively helped the teacher and researcher. On the teacher side, it makes their work less complicated when they need to provide activities and exercises to their students. The Sugary Math Adventure Worksheet is an organized and interesting instrument that develops numeracy skills at an early age. It eradicates the traditions of moving on to the next set of exercises when students make a mistake. Instead, this worksheet promotes mastery of a lesson by consistent practice and skills enhancement, making sure that primary-level students fully understand

the concept of different fundamental operations in math before proceeding. In that way, it lessens the need for teachers to continuously create a new set of activities, because the worksheet is already clear and reusable based on how students used it. In addition, it reduces the teacher's talk time, as students work on the worksheet independently while the teacher is focused on facilitating and guiding them. This worksheet is not only to help students enhance their numeracy skills but also to make the teaching approach more structured and successful. Also, it helps to enhance the analytical thinking and problem-solving skills of the researcher, specifically in the teaching field. It helps to identify teaching tools that promote student mastery and help the teacher reduce their work. The procedure of graphic designing, executing, and assessing the Sugary Math Adventure Worksheet has built up the ability of the researcher to develop and evaluate instructional materials based on student needs. Overall, this research helps the researcher to become more critical and reflective in assessing teaching methods, which helps in future research projects.

CONCLUSION

The Sugary Math Adventure Worksheet was evaluated by mathematics education experts before implementation, who ensured its alignment with fundamental numeracy principles and Grade 1 math competencies. Based on the result of the study, the improved scores from pre-test to post-test of the students reflect the development of numeracy skills in all basic mathematical operations. Additionally, the students demonstrate fun and enjoyment in learning mathematics using the worksheet, as reflected in their self-assessment responses. The improved quarterly grades of the students also indicate that the worksheet made a positive impact on their academic achievement and their classroom performance. The research findings highlighted the importance of the Sugary Math Adventure Worksheet as a supplementary learning material to improve early learning education of Filipino children in mathematics. Mastery of fundamental math using bilingual instruction and interactive and engaging worksheets is crucial to build up children's numeracy skills across all mathematical operations. Also, this will result in students' increased motivation, fun, and engagement in classroom activities and academic achievement.

To broaden the study to produce more accurate results, the researcher recommends expanding the use of the Sugary Math Adventure worksheet to other section in the same public school and across different schools within Muntinlupa City to collect more comprehensive data on its effectiveness. The worksheet may also incorporated into the daily lecture to enhance mastery of the subject, which also enhances student engagement. Moreover, the worksheet needs to expand its scope by incorporating word problems, fractions, and recognition of Philippine currency. In addition, the researcher recommends conducting training sessions and workshops for the teachers that encourage them to create more worksheets that are engaging, fun, and promote mastery of the subject. Furthermore, it is recommended to engage an experimental approach in future studies by dividing the class into two groups. The first group will use the traditional method, and the second group will use the Sugary Math Adventure worksheet. This will give clearer validation of the worksheets' effectiveness in improving numeracy skills, achievement, and attitude of students towards the mathematics subject.

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