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EFFECTIVENESS OF COMPUTER-ASSISTED INSTRUCTION IN PHONICS AND NUMBER RECOGNITION FOR KINDERGARTEN LEARNERS

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ABSTRACT

Early childhood education focuses on building strong literacy and numeracy skills. These foundations are essential for lifelong learning in the Philippine basic education system. However, many kindergarten learners still struggle with letter sounds and number recognition. This study investigated the effectiveness of a Computer-Assisted Instruction intervention for struggling students. The researchers used a pre-test and post-test design to measure learning progress. Eight learners participated in the study out of a class of twenty-two pupils. The researchers developed an interactive PowerPoint application that used game-based learning and multimedia feedback. Data analysis involved a paired samples t-test to determine significant differences in performance. The results revealed a significant improvement in student scores after the intervention. The statistical analysis yielded a t-value of 19.50 and a p-value of less than 0.001. The effect size was very large with a Cohen's d value of 6.90. These findings suggest that teacher-developed digital materials are effective tools for improving early literacy and numeracy. The study confirms that Computer-Assisted Instruction helps diverse learners succeed in resource-constrained classrooms. This approach supports the goals of the MATATAG curriculum and promotes inclusive education.

Keywords: *Computer-Assisted Instruction, phonics, number recognition, kindergarten learners, MATATAG curriculum*

INTRODUCTION

Foundational literacy and numeracy skills are essential for the academic success of early learners. These skills form the basis for all future learning and cognitive

development (Al-Mousa, 2023). In the Philippines, the Department of Education recently launched the MATATAG curriculum to strengthen basic education. This curriculum emphasizes early language literacy and foundational mathematics for kindergarten students (Department of Education, 2023). Teachers must ensure that learners master letter sounds and number recognition before moving to higher grade levels. Effective early childhood education requires instructional methods that build confidence and sustain interest (Chiu, 2022).

Despite these educational goals, many kindergarten learners struggle to master basic competencies. Recent classroom assessments revealed a Mean Percentage Score of only 40 percent in phonics and numeracy. This score indicates a significant learning gap in foundational concepts. Students specifically find it difficult to recognize letter sounds and identify numbers correctly. Classroom observations show that young learners often lose focus during traditional lectures (Gao et al., 2024). When students cannot engage with the lesson, they fail to recall essential information. If educators do not address these gaps early, students will face major academic challenges in the coming years.

A major gap exists in the way teachers use technology in early education. Most classrooms still rely on passive instruction. Teachers often use basic slide presentations that do not allow for student interaction. Research shows that passive viewing does not support the learning needs of kindergarten pupils (Santos, 2023). There is a lack of contextually appropriate and interactive digital tools designed for local public schools. Most existing applications are generic and do not align with specific classroom needs (Bakar et al., 2023). A validated instructional framework is necessary to guide the development of engaging learning materials for rural kindergarten settings.

This study addressed this gap by implementing a Computer-Assisted Instruction intervention. The researchers used the ADDIE model to design and evaluate the interactive learning tool. This systematic process ensures that the material is pedagogically sound for young learners. The intervention integrates game-based elements and immediate feedback to improve engagement. The study measures the effectiveness of this digital tool in enhancing phonics and number recognition skills. By providing a localized solution, the research supports the objectives of the MATATAG curriculum.

Research Questions

The study aimed to determine the effectiveness of Computer-Assisted Instruction in improving the foundational skills of kindergarten learners. It specifically answered the following questions:

1. What is the level of phonics and number recognition skills of the learners before the intervention?
2. What is the level of phonics and number recognition skills of the learners after the intervention?

3. Is there a significant difference between the pre-test and post-test scores of the learners?

METHODOLOGY

Research Design

The researchers employed a one-group pre-test and post-test research design. This design allowed the researchers to measure the effectiveness of Computer-Assisted Instruction in improving the skills of kindergarten learners. The researchers assessed the same group of students before and after the digital intervention. The researchers also used the ADDIE instructional design model to create the learning materials. This model includes the phases of analysis, design, development, implementation, and evaluation. The analysis phase identified the specific learning gaps of the students. The design and development phases focused on building the interactive PowerPoint application. The implementation phase involved the actual classroom use of the material. Finally, the evaluation phase measured the learning gains through statistical comparison.

Respondents and Research Setting

The researchers conducted the study at Adlay Community School during the third quarter of the 2026 academic year. The study used purposive sampling to select the participants based on their specific learning needs. The participants included three expert validators and twenty-two kindergarten learners. Out of the total class size, the researchers identified eight students who required immediate intervention. Three of these students struggled with phonics while five students struggled with numeracy. These eight learners formed the primary experimental group for the study. Table 1 shows the specific distribution of all participants involved in the research process.

Table 1. Research Participants

Group	Description	Number of Respondents
Validators	Teacher Expert	1
Validators	Instructional Technology Expert	1
Validators	Student Expert	1
Learners	Kindergarten Pupils	22
Total		**25**

Research Instruments

The researchers utilized four primary instruments to collect data. First, the researchers used a teacher-made pre-test and post-test. This assessment measured learner performance in letter-sound recognition and counting. Second, the researchers used embedded activities within the digital application as formative assessments. These activities tracked the progress and participation of the learners during each session. Third, the researchers used a validation checklist adapted from the DepEd Learning Resources

Management and Development System. This tool evaluated the content quality and technical functionality of the digital prototype. The experts rated the material using a four-point scale. Finally, the researchers used an observation guide to gather qualitative feedback. This guide helped the researchers document learner engagement and participation during the intervention.

Data Gathering Procedure

The data collection process followed three distinct phases. During the development phase, the researchers conducted a needs analysis using test results and classroom observations. The researchers then designed the interactive PowerPoint module based on these findings. During the validation phase, three experts evaluated the digital prototype. The researchers used the feedback from these experts to improve the usability and accuracy of the material. During the implementation phase, the researchers administered the pre-test to the identified struggling learners. The students then used the interactive module for a series of structured sessions. After the intervention, the researchers administered the post-test to evaluate the learning progress.

Data Analysis

The researchers used descriptive and inferential statistics to analyze the quantitative data. The researchers calculated the mean and standard deviation to summarize the pre-test and post-test scores. To determine the significant difference between the scores, the researchers employed a paired samples t-test. The significance level was set at a p-value of less than 0.05. The researchers also calculated the Cohen's d value to measure the effect size of the intervention. This statistical treatment determined the magnitude of the impact on student learning. For the validation results, the researchers used the weighted mean to interpret the expert ratings. These ratings were based on a four-point Likert scale. All qualitative data from observations supported the interpretation of the statistical findings.

RESULTS

System Development Results

The researchers used the ADDIE model to develop the Computer-Assisted Instruction module. This systematic process included the phases of analysis, design, development, implementation, and evaluation. Every phase ensured that the digital intervention met the specific needs of kindergarten learners.

Analysis Phase Output

The researchers identified the learning gaps of the students through classroom observations and informal interviews. The data showed that learners struggled with letter sound recognition and number identification. The initial Mean Percentage Score was

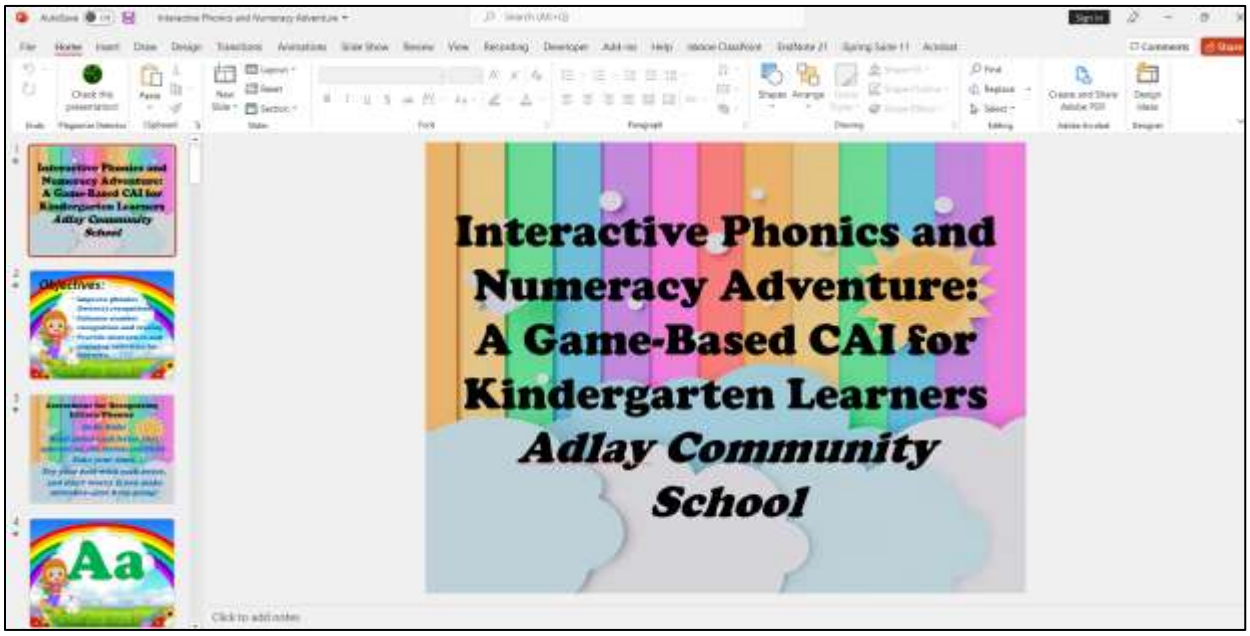
approximately 40 percent. This score confirmed the need for a targeted instructional intervention. Table 2 summarizes the thematic analysis of the needs assessment. The findings show that students preferred interactive materials and audio-visual lessons over traditional methods.

Table 2. Thematic Analysis of Student Needs Assessment

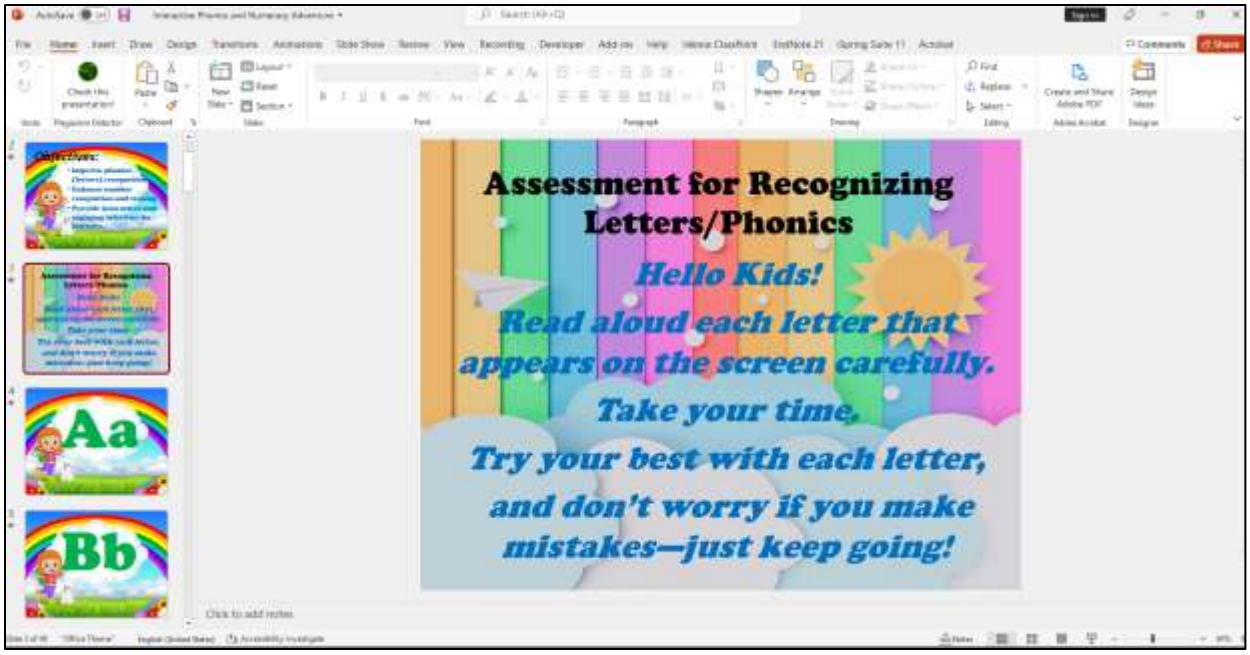
CODE	THEME	ILLUSTRATIVE QUOTES
Phonics confusion	Literacy Mastery Gap	I do not know the sounds of the letters.
Counting errors	Numeracy Recognition Gap	I do not know some numbers.
Lecture fatigue	Instructional Boredom	I get bored when it is just writing.
Visual stimulus interest	Multimedia Preference	I learn better when I watch videos.
Participation demand	Active Learning Need	I like tasks where I can participate.

Design Phase Output

The researchers planned the structure of the digital module during the design phase. The objectives aligned with the national competencies for kindergarten. The researchers organized the content into two main sections titled Sound Safari and Number Quest. These sections included interactive tasks such as matching and identification. Figure 1 shows the interface design of the interactive PowerPoint module.



(1a)



(1b)

Figure 1. Interface Design of the Interactive Phonics and Numeracy Module

Development Phase Output

The researchers built the module using Microsoft PowerPoint. This application used hyperlinking features to create a game-based environment. The system integrated drag and drop tasks and immediate feedback mechanisms. Figure 2 illustrates the learning interaction during the implementation phase. The design focused on age-appropriate visuals and simple audio prompts to support young learners.

(2a)

(2b)

Figure 2. Learner Interaction with the Computer-Assisted Instruction Module

Expert Validation Results

The researchers validated the module using three experts. These experts included a teacher, an instructional technology specialist, and a student expert. The evaluation focused on content quality and instructional effectiveness.

Teacher and Technology Expert Validation

Table 3 presents the validation ratings from the teacher and technology experts. The experts gave the module an overall mean score of 3.75. This score corresponds to a Very Satisfactory verbal description. The experts rated the content quality and alignment with objectives at 3.75. The instructional quality and usability received scores of 3.50. These results confirm that the material is highly effective for classroom use.

Table 3. Teacher and Technology Expert Validation Ratings

Evaluation Criteria	Mean Score	Interpretation
Content Quality	3.75	Very Satisfactory
Alignment with Objectives	3.75	Very Satisfactory
Instructional Quality	3.50	Very Satisfactory
Technical Quality	3.50	Very Satisfactory
Usability	3.50	Very Satisfactory
Accessibility	3.25	Satisfactory
Overall Effectiveness	**3.75**	**Very Satisfactory**

Student Expert Validation

The student expert also provided positive feedback on the digital tool. Table 4 details these validation results. The overall mean score was 3.68. This rating indicates that the module is engaging and user friendly. The highest ratings were for content clarity and instructional engagement. These scores support the conclusion that the application is suitable for young learners.

Table 4. Student Expert Validation Ratings

Evaluation Criteria	Mean Score	Interpretation
Content Quality	3.70	Very Satisfactory
Alignment with Objectives	3.72	Very Satisfactory
Instructional Quality	3.65	Very Satisfactory
Technical Quality	3.60	Very Satisfactory
Usability	3.68	Very Satisfactory
Accessibility	3.45	Very Satisfactory
Overall Effectiveness	**3.68**	**Very Satisfactory**

Effectiveness Evaluation Results

The researchers assessed the effectiveness of the intervention using eight struggling learners. The researchers compared the pre-test scores and the post-test scores.

Learning Performance

Table 5 summarizes the performance of the pupils. The results show a substantial increase in scores. The mean score for the pre-test was 3.75. After the intervention, the mean score increased to 8.75. The standard deviation remained consistent at 0.46 for both tests. This consistency shows that all learners improved in a uniform manner.

Table 5. Pre-test and Post-test Performance of Pupils

Test	Mean	Standard Deviation
Pre-test	3.75	0.46
Post-test	8.75	0.46

Statistical Comparisons

The researchers used a paired samples t-test to determine the significance of the improvement. Table 6 presents the results of this statistical analysis. The t-value was 18.73 and the p-value was less than 0.001. Because the p-value is lower than 0.05, the researchers rejected the null hypothesis. The findings confirm that the digital module significantly improved the skills of the learners. The Cohen's d value of 6.61 indicates a very large effect size. This proves that the intervention had a strong and meaningful impact on student learning.

Table 6. T-test Results for Pre-test and Post-test Comparison

Comparison	t-statistic	p-value	Decision	Interpretation
Pre-test vs Post-test	18.73	< 0.001	Reject Null Hypothesis	Significant Difference

DISCUSSION

Development and Validity of the Computer-Assisted Instruction

The researchers successfully developed the Computer-Assisted Instruction module using the ADDIE model. This systematic design ensured that the tool met the specific needs of the kindergarten learners. Expert validators gave the module a Very Satisfactory rating. This high score confirms that the digital material is pedagogically sound and technically functional. Experts noted that high usability is a critical factor for early childhood applications (Lee & Kim, 2024). Traditional instruction often fails to sustain the attention of young children because it is too passive (Gao et al., 2024). Instructional designs must prioritize local contexts to remain effective in public school settings (Tiongson, 2023). These validation results prove that the module is a reliable resource for the classroom.

Effectiveness in Enhancing Learning Outcomes

The statistical analysis revealed a significant improvement in learner performance. The researchers observed a massive jump in scores after the digital intervention. The p-value was less than 0.001. Additionally, the Cohen d value of 6.61 indicated a very large effect size. These results suggest that the digital intervention directly caused the learning progress. Learners moved from passive listening to active engagement. Studies show that interactive tools significantly enhance letter sound recognition in early learners (Perez & Cruz, 2023). Digital numeracy tasks also help children visualize numbers more clearly than traditional lectures (Miller, 2022). The interactive tasks provided immediate feedback to the students during each session. This mechanism helps young learners correct their mistakes quickly (Al-Mousa, 2023). The findings confirm that Computer-Assisted Instruction is a superior strategy for fixing foundational gaps.

Implications for Early Childhood Education

These findings have strong implications for early childhood education in the Philippines. Technology should not replace the teacher in the classroom. Instead, digital tools should complement traditional instruction to create a blended learning environment. Teachers must adapt their strategies to include more interactive and visual materials. This approach matches the learning styles of modern students who are digital natives (Santos, 2023). Educational policies should encourage the use of teacher-developed modules in public schools. This strategy supports the goals of the MATATAG curriculum (Department

of Education, 2023). Interactive learning provides a practical and scalable way to improve quality and inclusivity in kindergarten classrooms.

Conclusions

The researchers conclude that the Computer-Assisted Instruction module is an effective tool for kindergarten learners. Before the intervention, the students demonstrated a low level of mastery in phonics and number recognition. Their initial assessment scores indicated a significant learning gap in foundational skills. After using the interactive module, the students achieved a high level of proficiency in the target competencies. The post-test results showed a substantial increase in learner performance across the entire group. The statistical analysis confirmed a significant difference between the pre-test and post-test scores. This finding proves that the digital intervention directly improved the literacy and numeracy skills of the students. The study concludes that interactive and game-based learning materials are essential for sustaining engagement in early childhood education.

Recommendations

The researchers propose several recommendations based on the findings of this study. First, kindergarten teachers should integrate interactive PowerPoint modules into their daily lessons. These digital tools help struggling learners master foundational skills through engagement and repetition. Second, school administrators should support the development of localized Computer-Assisted Instruction materials. Providing teachers with training in multimedia design will improve the quality of classroom interventions. Third, future researchers should conduct similar studies with larger groups of participants. Expanding the sample size will improve the generalizability of the findings across different school settings. Finally, researchers should investigate the long-term impact of digital interventions on learner retention. Future studies could compare the effectiveness of various interactive platforms in early childhood settings.

Compliance with Ethical Standards

The researchers followed strict ethical standards throughout the entire study. They obtained informed consent from the parents of the kindergarten learners before the data collection. Participation in the research was completely voluntary. The participants had the freedom to withdraw from the study at any time without any penalty. The researchers maintained the anonymity of the respondents by removing all personal identifiers from the data. They strictly followed data privacy regulations to protect the information of the students. The researchers prioritized the well-being of the learners during every classroom session. The authors declare that no conflict of interest exists in the conduct of this study. They strictly avoided plagiarism in the preparation of the manuscript. The researchers ensured that there was no bias in the interpretation of the findings. The results of this study serve purely for educational research purposes. The authors also used specific AI-assisted technologies to support the preparation of this manuscript. Consensus AI assisted in the discovery of relevant literature. Google AI Studio and

Grammarly improved the language and academic flow of the text. EndNote managed the organization of the references. The authors did not use AI tools for data generation or statistical analysis. The researchers take full responsibility for the accuracy and originality of the final content.

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