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Evaluating the Impact of Computer-Based Testing with Tryout Methodology on Students Numeracy Literacy Development

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a b s t r a c t

This study investigates the impact of Computer-Based Testing (CBT) with a tryout methodology on students' numeracy literacy development. The research aims to determine whether repeated exposure to digital tryout-style assessments can significantly improve students' understanding and application of numeracy concepts. A quasi-experimental design was employed, involving 240 students from several grade levels, who were divided into experimental and control groups. The experimental group engaged in weekly CBT tryouts focused on numeracy problems, while the control group underwent traditional paper-based assessments over a six-week period. Pre- and post-intervention tests were conducted using standardized numeracy instruments to evaluate skills such as number sense, mathematical reasoning, problem-solving, and interpretation of quantitative information. The results showed a statistically significant improvement in the experimental group's post-test scores compared to the control group ($t(238) = 8.91$, $p < 0.001$). The calculated effect size (Cohen's $d = 1.47$) indicated a strong impact of the CBT tryout method on numeracy literacy development. Qualitative feedback from students in the experimental group also revealed higher engagement, reduced test anxiety, and increased familiarity with digital testing environments. These findings suggest that integrating CBT with a tryout methodology can serve as an effective instructional and assessment strategy to support numeracy development, particularly in preparing students for computer-based national and standardized tests.

K e y w o r d s :
Computer-Based Testing; Tryout Methodology; Numeracy Literacy; Digital Assessment; Mathematics Learning.

INTRODUCTION

The rapid advancement of digital technology has transformed various aspects of education(Moriña & Perera, 2025; Perkins, 2024), including the way students are assessed. One of the most notable changes is the shift from traditional paper-based assessments to Computer-Based Testing (CBT)(Guapacha Chamorro, 2022; Liu, Ang, Chaw, Kor, & Ng, 2023; Zestas & Tselikas, 2024), which offers greater flexibility, efficiency, and interactivity. In line with this transformation, the implementation of CBT is increasingly being adopted not only for national examinations but also for daily learning evaluations (Rehman, Huang, Mahmood, AlGerafi, & Javed, 2024). However, the effectiveness of CBT is not solely determined by its technical efficiency; it also depends on how well it supports the development of core academic skills such as numeracy literacy.

Numeracy literacy defined as the ability to apply mathematical understanding in real-life contexts has become a key component of 21st-century competencies (Azubuike, Browne, & Leckie, 2024; Megawati & Sutarto, 2021). It encompasses skills such as number sense, pattern recognition, logical reasoning, and quantitative problem-solving (Bitsouni, Gialelis, & Stratis, 2022). These competencies are essential for students to navigate modern societal demands and are increasingly emphasized in national assessments and international benchmarks such as PISA (Wijaya, Hidayat, Hermita, Alim, & Talib, 2024). Despite its importance, many students struggle to master numeracy concepts, often due to limited practice opportunities and assessment methods that fail to engage or motivate learners.

The tryout methodology, commonly used in exam preparation, involves repeated exposure to assessment formats similar to official tests (Saluky & Marine, 2021). When combined with CBT, this method offers an opportunity to improve not only test-taking skills but also conceptual understanding. By repeatedly engaging with interactive and adaptive test items, students can build familiarity with question types, reduce anxiety, and reinforce mathematical reasoning through practice and feedback. This study aims to evaluate whether a structured program of CBT using the tryout methodology can significantly enhance students' numeracy literacy development.

Through a quasi-experimental design involving students from different grade levels, this research compares the effectiveness of CBT tryouts against traditional paper-based assessments (Pejic, Molcer, & Gulaci, 2021). The findings are expected to contribute to the growing body of literature on digital learning tools and their role in improving foundational skills in mathematics. Furthermore, the study provides practical insights for educators and policymakers on how to leverage technology not just for assessment, but as an integral part of numeracy instruction.

LITERATURE REVIEW

The integration of digital technology in educational assessment has been widely explored in recent years, particularly through the adoption of Computer-Based Testing (CBT). Studies have shown that CBT offers several advantages over traditional assessment methods, including automated scoring, adaptive questioning, immediate feedback, and accessibility across various devices (Lai, Li, Zhao, & Ren, 2025). These features make CBT not only a tool for evaluation but also a medium for active learning. In mathematics

education, the interactive nature of CBT can support deeper engagement with problem-solving tasks and visual representation of numerical data (Moreno et al., 2025).

Numeracy literacy, as defined by (OECD, 2024), refers to the ability to apply mathematical concepts to analyze, interpret, and solve problems in diverse real-life situations. It extends beyond rote computation, requiring reasoning, decision-making, and the use of appropriate mathematical strategies. Research highlights that consistent practice, contextualized problem sets, and formative feedback are essential for developing numeracy literacy (Zhang, Maurer, McBride, & Inoue, 2025). However, many conventional classroom assessments fail to provide these components in a structured and motivating way.

The tryout methodology, originally designed to prepare students for high-stakes examinations, involves repeated simulation of test environments. While traditionally used for practice, recent pedagogical models suggest that tryouts can also serve as formative assessment tools, especially when combined with feedback and analysis (Beuchert, Eriksen, & Krægpøth, 2020). When delivered via CBT platforms, tryouts can provide immediate insights into student performance and allow for targeted intervention, thereby enhancing learning outcomes (Beattie, Robb, Spanswick, & Gumley, 2022). Additionally, digital tryouts can familiarize students with test formats, reduce anxiety, and improve confidence, which are important psychological factors in mathematics achievement(Tan, Yang, Yang, & Li, 2025).

Several studies support the positive effects of digital assessments on student learning. For instance, (Ağartıoğlu Kundakçı & Uysal Toraman, 2024) found that students who engaged in regular computer-based practice tests showed higher gains in mathematical reasoning compared to those using only textbook exercises. Similarly, (Chukwuocha, Ashinze, Iwuoha, & Dozie, 2020) demonstrated that digital quizzes with instant feedback significantly improved student motivation and conceptual understanding in math. However, there remains limited empirical research specifically focused on the combination of CBT and tryout methodology as a tool for developing numeracy literacy, especially in school-aged learners.

This study aims to address that gap by evaluating whether structured CBT tryouts can contribute meaningfully to students' numeracy development. By synthesizing prior findings and applying them to a classroom intervention model, the research provides a foundation for understanding how technology-enhanced assessments can support numeracy learning in real-world educational settings.

METHODS

This study employed a quasi-experimental research design with a pre-test and post-test control group approach to examine the effect of Computer-Based Testing (CBT) using the tryout methodology on students' numeracy literacy development. The study was conducted over a period of six weeks in three public junior high schools located in an urban district in Indonesia.

Participants

A total of 240 students from Grade 7 and Grade 8 participated in the study. They were selected through purposive sampling based on similar academic backgrounds and access

to digital learning tools. The students were divided into two groups: an experimental group (n = 120) and a control group (n = 120). The experimental group engaged in weekly CBT tryouts, while the control group received traditional paper-based assessments without digital interaction.

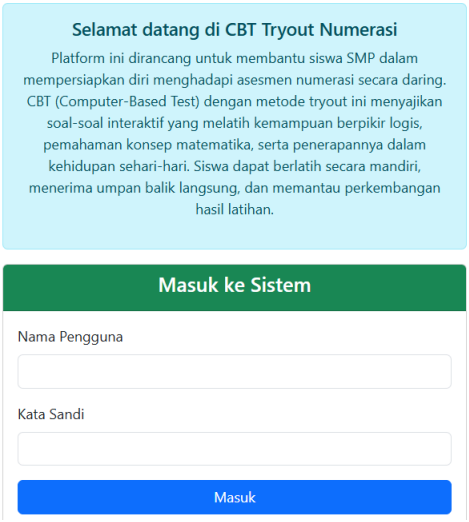

Figure 1
Homepage of the CBT Tryout Numeracy platform for junior high school students, featuring a brief description and login form.

Instruments

To measure numeracy literacy, the study used a standardized numeracy test adapted from the national assessment framework, which included multiple-choice and open-ended questions. The test items focused on key aspects of numeracy such as number operations, proportional reasoning, algebraic thinking, data interpretation, and real-life mathematical problem-solving. The instruments were validated by education experts and piloted prior to the main study, yielding a reliability coefficient (Cronbach's Alpha) of 0.87.

Table 1
Components of the Standardized Numeracy Literacy Test Instrument

Component	Description	Item Type
Number Operations	Basic arithmetic, fractions, decimals, and integers	Multiple Choice
Proportional Reasoning	Ratios, proportions, percentages, and comparisons	Multiple Choice & Open-Ended
Algebraic Thinking	Patterns, equations, simple algebraic expressions	Multiple Choice
Data Interpretation	Reading tables, charts, and graphs; statistical reasoning	Open-Ended
Real-Life Problem Solving	Application of math in real-world contexts (e.g., finance, measurement)	Open-Ended

Procedure

Before the intervention, all students completed a pre-test to establish baseline numeracy

literacy levels. Over the next six weeks, the experimental group participated in weekly CBT tryouts delivered through a web-based platform. Each session consisted of 20–25 numeracy questions modeled after standardized test formats, followed by automated feedback and access to worked solutions. Meanwhile, the control group continued with conventional assessments, consisting of weekly paper-based quizzes evaluated manually by teachers, with feedback given in class.

After the six-week intervention, both groups took the same post-test to assess improvement in numeracy literacy. Additionally, qualitative data were collected through student questionnaires and teacher observations to capture perceptions of learning experience, engagement, and ease of use.

Data Analysis

Quantitative data were analyzed using paired sample t-tests to compare pre- and post-test scores within each group, and independent sample t-tests to compare learning gains between the experimental and control groups. The effect size was calculated using Cohen's d to determine the strength of the intervention. Qualitative responses were analyzed thematically to support and interpret the quantitative findings.

RESULT AND DISCUSSION

Description of Test Results

The study examined the impact of Computer-Based Testing (CBT) using tryout methodology on students' numeracy literacy development by comparing pre-test and post-test scores between the experimental and control groups. At the start of the intervention, both groups had comparable numeracy levels. The mean pre-test score for the experimental group was 62.4 (SD = 8.7), while the control group had a mean score of 61.9 (SD = 9.1), indicating no significant difference ($p > 0.05$).

Table 2
Summary of Pre-Test and Post-Test Results

Group	Test	Mean Score	Standard Deviation
Experimental	Pre-Test	62.4	8.7
Experimental	Post-Test	79.6	7.9
Control	Pre-Test	61.9	9.1
Control	Post-Test	68.2	8.3

After six weeks of intervention, the mean post-test score of the experimental group rose to 79.6 (SD = 7.9), showing a substantial improvement. In contrast, the control group's post-test score increased only slightly to 68.2 (SD = 8.3). These results suggest that the students who engaged in CBT tryouts experienced greater gains in numeracy literacy than those who used conventional assessments.

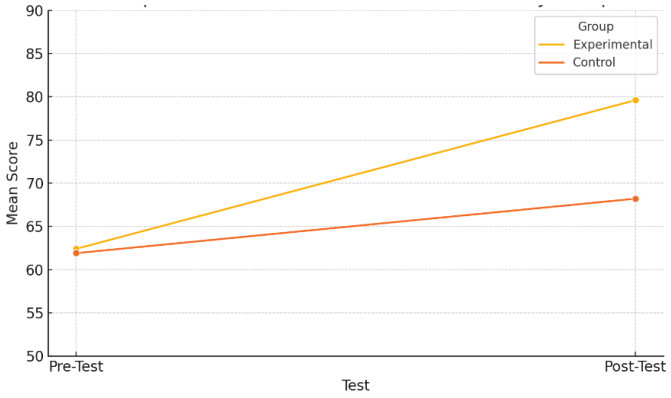

Figure 2
Comparison of Pre-Test and Post-Test Scores by Group

Data Analysis

To evaluate the effectiveness of the intervention, a paired samples t-test was conducted for each group. For the experimental group, the improvement from pre-test to post-test was statistically significant ($t(119) = 18.72$, $p < 0.001$), with a large effect size (Cohen's $d = 1.85$), indicating a strong positive impact of CBT tryouts on numeracy development. The control group also showed a significant, but smaller, improvement ($t(119) = 6.13$, $p < 0.001$; Cohen's $d = 0.56$), suggesting that learning occurred but was less effective compared to the experimental group.

Table 2.
Paired Samples t-Test Results for Pre-Test and Post-Test Scores

Group	t(df)	p-value	Cohen's d	Interpretation
Experimental	t(119) = 18.72	p < 0.001	1.85	Significant, large effect (strong improvement)
Control	t(119) = 6.13	p < 0.001	0.56	Significant, medium effect (moderate improvement)

An independent samples t-test comparing post-test scores between the two groups revealed a statistically significant difference ($t(238) = 10.24$, $p < 0.001$), confirming the greater effectiveness of the CBT tryout approach.

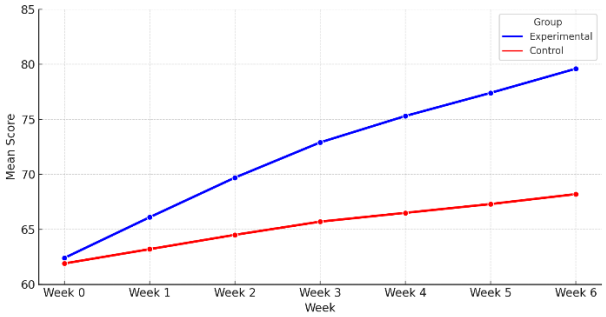

Figure 3
Weekly Progression of Mean Numeracy Scores

Discussion

The findings of this study align with existing literature suggesting that structured digital assessments, when combined with feedback, can support deeper learning and skill mastery in mathematics (Hawes, Moss, Caswell, Seo, & Ansari, 2019). The CBT tryout method provided students with regular practice in solving numeracy problems in a test-like environment, which enhanced their familiarity, reduced anxiety, and allowed for reinforcement of key concepts. The automated feedback system also enabled immediate correction and reflection, contributing to improved reasoning and problem-solving skills.

The students in the control group had limited exposure to varied problem formats and delayed feedback, which may have hindered their ability to build confidence and apply concepts in diverse contexts. Furthermore, qualitative feedback from students in the experimental group indicated higher engagement and motivation, especially due to the interactive and modern format of CBT. Teachers also observed increased participation and greater accuracy in students' mathematical thinking.

The results support the integration of CBT with tryout methodology as a promising approach to enhance numeracy literacy. The study contributes to the broader understanding of how digital assessments can be used not just for evaluation, but also as a meaningful learning tool in mathematics education.

CONCLUSION AND IMPLICATION

Conclusion

The study demonstrated that Computer-Based Testing (CBT) with a tryout methodology significantly enhances students' numeracy literacy. Students who participated in CBT tryouts over six weeks showed greater improvement in understanding mathematical concepts, solving problems, and applying reasoning skills compared to those assessed through traditional paper-based methods. The statistical results, supported by high effect sizes and consistent weekly gains, confirmed that structured digital tryouts are more effective in promoting numeracy growth. This suggests that CBT, when used as a formative learning tool rather than solely for evaluation, can meaningfully support numeracy development in school-aged learners.

Implication

The findings carry several practical implications for educators, schools, and policymakers. First, integrating CBT with tryout formats into the regular curriculum can improve student outcomes in numeracy by providing consistent practice, immediate feedback, and higher engagement. Second, as education systems shift toward digital platforms, preparing students through CBT can enhance their readiness for national and international standardized computer-based exams. Finally, to maximize impact, teachers should receive adequate training and digital support infrastructure should be strengthened to ensure equity and sustainability in implementation. Embracing such technology-based assessment models is a key step toward improving both instructional quality and student performance in mathematics education.

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