

Enhancing Primary Year 2 Learning numbers within 1000 with Digital Storytelling

*Pemantapan Penguasaan Nombor hingga 1000 bagi Murid Tahun 2 melalui Bercerita
Secara Digital*

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Diterima: 27 Ogos 2024; **Disemak semula:** 03 Mac 2025 **Diterima:** 10 April 2025; **Diterbitkan:** 30 April 2025

To cite this article (APA): Lu, C. S. C., & Fu, S. H. (2025). Enhancing Primary Year 2 Learning numbers within 1000 with Digital Storytelling. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, 15(1), 60-66. <https://doi.org/10.37134/jpsmm.vol15.1.5.2025>

To link to this article: <https://doi.org/10.37134/jpsmm.vol15.1.5.2025>

ABSTRACT

This study explores the impacts of using digital storytelling to enhance Primary 2 students numeracy skills, specifically focusing on numbers within 1000. Employing a one-group pretest-posttest design, the research involved 35 students who were exposed to a series of interactive digital stories designed to teach numerical concepts and procedural fluency. The digital stories integrated narrative elements with mathematical problems, providing a context-rich environment for students to engage with numbers and operations. Pretest and posttest assessments were administered to evaluate the students' understanding of numerical concepts and their procedural fluency. The mean score increased from **44.11** (SD = 22.75) in the pre-test to **65.17** (SD = 23.86) in the post-test, resulting in a mean difference of **21.06**. A paired samples t-test showed that this difference was statistically significant, $t = -4.788$, $p < .001$. The results indicated a significant improvement in both areas, suggesting that digital storytelling can be a valuable tool in early mathematics education. This study highlights the potential of integrating technology and narrative-based learning to foster deeper mathematical understanding and engagement among young learners.

Keywords: digital storytelling, primary mathematics, numbers

ABSTRAK

Kajian ini bertujuan meneroka impak penggunaan bercerita secara digital dalam meningkatkan kemahiran numerasi bagi murid Tahun 2, khususnya dalam topik nombor hingga 1000. Kajian ini menggunakan reka bentuk pra-ujian dan pasca-ujian yang satu kumpulan melibatkan 35 orang murid. Responden tersebut didedahkan kepada siri bercerita digital secara interaktif yang dibangunkan khusus untuk mengajar konsep nombor dan meningkatkan kefasihan prosedural. Bercerita secara digital ini menggabungkan elemen naratif dengan masalah matematik, dan menyediakan konteks yang berkaitan dengan persekitaran bagi murid untuk berinteraksi dengan nombor dan operasi. Penilaian pra-ujian dan pasca-ujian telah dijalankan bagi menilai kefahaman murid terhadap konsep nombor dan kefasihan prosedural mereka. Skor min meningkat daripada 44.11 (SP = 22.75) dalam pra-ujian kepada 65.17 (SP = 23.86) dalam pasca-ujian, menghasilkan perbezaan min sebanyak 21.06. Ujian t sampel berpasangan menunjukkan perbezaan ini adalah signifikan dari segi statistik, $t = -4.788$, $p < .001$. Keputusan menunjukkan peningkatan yang signifikan dalam kedua-dua aspek, yang mencadangkan bahawa bercerita secara digital berpotensi menjadi cara pengajaran yang bernilai dalam pendidikan awal matematik. Kajian ini menyerlahkan potensi integrasi teknologi dan pembelajaran berasaskan naratif dalam memupuk pemahaman matematik yang lebih mendalam dan penglibatan aktif dalam kalangan murid.

Kata kunci: bercerita secara digital, matematik sekolah rendah, nombor

INTRODUCTION

In the contemporary global landscape, proficiency in mathematics is increasingly recognized as a crucial determinant of academic success and future employability. The Programme for International Student Assessment (PISA), administered by the Organisation for Economic Co-operation and Development (OECD), provides a comparative measure of 15-year-old students' abilities in reading, mathematics, and science across various countries (OECD, 2022). Malaysia's performance in the PISA assessments has a bit lower than the global average, particularly in mathematics (OECD, 2022). This performance raises concerns about the effectiveness of current educational practices and highlights the urgent need for innovative approaches to enhance numeracy skills among Malaysian students from an early age. Also, Mathematics is a compulsory subject in both the primary and secondary school curriculum (May & Ahmad, 2020).

In response to this challenge, educators and researchers are exploring various pedagogical strategies to improve mathematical understanding and engagement among young learners. For example, Tiong et al. (2021) propose streamlined approaches such as the ESE Problem-Solving Model, which provides a clear, systematic method for students to 'explore questions in actions' by extracting, synthesizing, and executing solutions. One such innovative approach is the use of digital storytelling, a method that integrates multimedia elements such as text, audio, images, and video to create engaging and interactive narratives (Wu & Chen, 2020). Digital storytelling has been shown to be effective in enhancing literacy skills and overall student motivation, but its potential for developing numeracy skills remains underexplored (Wu & Chen, 2020).

This experimental research study aims to address this gap by investigating the impact of digital storytelling on the numeracy skills of Primary 2 students in Johor Bahru, Malaysia. By integrating digital storytelling into the mathematics curriculum, this study seeks to determine whether this approach can foster a deeper understanding of mathematical concepts, improve problem-solving abilities. The findings of this research could provide valuable insights for educators and policymakers striving to elevate Malaysia's standing in future mathematics assessments and enhance the overall quality of mathematics education in the country.

RESEARCH OBJECTIVE

1. Determine the impacts of the digital storytelling in helping primary year two pupils to learn numbers within 1000.

LITERATURE REVIEW

Numeracy, the ability to understand and work with numbers, is a fundamental skill that underpins much of daily life and is crucial for academic success (Haylock & Manning, 2018). Developing strong numeracy skills in early childhood sets the foundation for future learning in mathematics and related fields (Haylock & Manning, 2018). Research indicates that early numeracy skills are predictive of later achievement in mathematics and overall academic performance (Mueller et al., 2024). Effective numeracy education at the primary level can significantly influence a student's long-term educational trajectory and career prospects (Mueller et al., 2024). Despite the critical importance of numeracy, Malaysia has faced ongoing challenges in achieving satisfactory levels of mathematical proficiency among its students. The country's performance in the PISA assessments has consistently been below the international average, particularly in mathematics (OECD, 2022). This performance highlights an issue within the Malaysian digital education, including teachers' competency, professional development, and limited resources (Yin & Mohamad Maslawati, 2023). Addressing these challenges requires innovative and effective educational strategies to enhance numeracy skills from an early age.

Digital storytelling combines narrative with digital multimedia, such as text, images, audio, and video, to create engaging and interactive educational content. This method has been shown to enhance literacy skills, foster creativity, and improve student motivation by leveraging the human affinity for stories, making learning more relatable and memorable (Wu & Chen, 2020). While its use in literacy education is well-documented, digital storytelling's potential for developing numeracy skills is emerging. It can contextualize mathematical concepts within engaging narratives, helping students understand abstract ideas through concrete examples and see the real-life relevance of math (Wu & Chen, 2020). The technique increases student engagement and motivation, making learning more enjoyable and accessible, which can reduce math anxiety and build a positive attitude towards the subject (Wu & Chen, 2020). Despite challenges such as the need for teacher training and technological infrastructure, the benefits of digital storytelling, including enhanced engagement and improved understanding of complex concepts, make it a promising strategy for modernizing mathematics education in Malaysia. Future research should explore the specific mechanisms through which digital storytelling impacts numeracy and identify best practices for its implementation (Wu & Chen, 2020).

AI-generated adaptive visual content tailors educational experiences to individual learners' needs by dynamically adjusting visuals and interactive elements based on real-time data (Sharma et al., 2024). In the context of teaching, this technology can modify animations, diagrams, and visual aids to align with a student's comprehension level and learning pace (Sharma et al., 2024). For instance, while teaching mathematical concepts such as counting or addition, AI can present more complex visual challenges as a student's proficiency improves or simplify them when difficulties are detected. This personalization helps maintain engagement and provides appropriate support, ensuring that each learner remains challenged yet capable of progressing. By continuously adapting to the learner's responses, AI-generated visual content fosters a deeper understanding and retention of educational material.

David Tall's "Three Worlds of Mathematics" framework describes three interconnected stages of mathematical understanding. The Conceptual-Embodied World focuses on learning through physical experiences and visualization, where learners build mental images of mathematical concepts (Tall, 2013). The Proceptual-Symbolic World transitions these physical experiences into symbolic representations, emphasizing the use of symbols and operations to perform mathematical tasks (Tall, 2013). Finally, the Axiomatic-Formal World involves abstract thinking, formal definitions, and logical reasoning, where learners engage with mathematics through proofs and axioms (Tall, 2013). This framework provides a comprehensive approach to developing mathematical understanding by connecting intuitive, symbolic, and formal aspects of mathematics.

Integrating David Tall's "Three Worlds of Mathematics" with digital storytelling and AI can enhance primary pupils' number sense within 1000 by creating a comprehensive learning framework. In the **Conceptual-Embodied World**, interactive AI-driven animations and augmented reality experiences help pupils visualize and physically engage with mathematical concepts. In the **Proceptual-Symbolic World**, digital stories incorporate symbolic problem-solving narratives, while AI provides adaptive learning systems and dynamic simulations for personalized feedback. For the **Axiomatic-Formal World**, logical and abstract narratives introduce formal concepts, supported by intelligent tutoring systems and interactive proof environments. This integration leverages narrative engagement and AI's adaptive capabilities to foster a deeper understanding and enjoyment of mathematics.

CONCEPTUAL FRAMEWORK STRUCTURE

Table 4.3: Integrating David Tall's Three Worlds with Digital Storytelling and AI

Mathematical World	Digital Storytelling	AI Multimedia Integration
Conceptual-Embodied	- Visual narratives and animations	- AI-generated adaptive visual content
Proceptual-Symbolic	- Story-based mathematical problems	- AI-driven personalized feedback
Axiomatic-Formal	- Abstract reasoning challenges	- AI-guided formal reasoning tasks

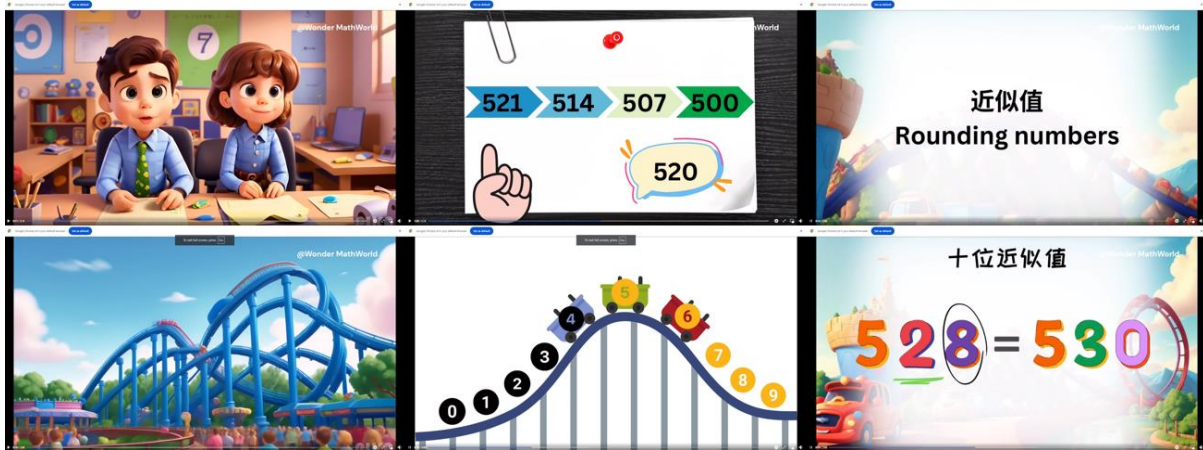
This framework synthesizes David Tall's Three Worlds of Mathematics with AI technologies and digital storytelling to revolutionize math education: Conceptual-Embodied World: AI-generated visuals (e.g., dynamic 3D animations) are embedded into narrative-driven videos (e.g., stories explaining functions through character adventures), grounding abstract ideas in tangible, relatable contexts. Proceptual-Symbolic World: AI tailors story-based problems (e.g., solving equations to unlock a quest's next chapter), offering adaptive feedback to build procedural fluency within engaging, contextualized challenges. Axiomatic-Formal World: AI-guided tools (e.g., theorem provers) scaffold abstract reasoning through narrative frameworks (e.g., solving logic-based mysteries), bridging intuition to formal proof.

In short, this framework reimagines mathematics as a story-driven adventure, where AI serves as both mentor and creative collaborator. By grounding abstract concepts in relatable narratives and adaptive technology, it bridges intuition and formalism, empowering students to master math with confidence and curiosity.

METHODOLOGY

This study employs a one-group pretest–posttest quasi-experimental research design to investigate the impact of digital storytelling on the development of numeracy skills among Primary 2 students in Johor Bahru, Malaysia. The mathematics teacher was trained with the use of digital storytelling in teaching mathematical problem for two days. The mathematics teacher taught only one group of her primary two pupils who participated in the digital storytelling for four weeks. Convenient sampling methods were used to gather only one group data for the participation of 35 primary two pupils at one of the national primary schools in Johor Bahru, Malaysia and there is no control group. The researchers included the participants that were available and voluntarily. This study intended to evaluate pupils' numeracy skills before and after using the digital storytelling. The group of pupils did the pretest with the traditional teaching methods, and before to the posttest, they were introduced to digital storytelling. Paired T-test was used to compare pretest and posttest results. Eventually, the researchers would examine the impact of digital storytelling among the pupils and provide empirical data on whether they have significant differences in their numeracy performance.

The intervention involves integrating digital storytelling into the mathematics curriculum for the experimental group over a period of a month. Digital stories will be designed to align with the existing numeracy curriculum, incorporating key mathematical concepts such as number value, writing numbers, number sequence, place value, estimate, round off numbers, number patterns and problem-solving. Each digital story will be crafted to include multimedia elements—such as text, images, audio, and video—to create engaging narratives that illustrate mathematical principles.



Create digital story using AI to teach numeracy skills

Ethical approval will be obtained from the relevant educational authorities and the school administration. Informed consent will be secured from the parents or guardians of the participating students. Confidentiality and anonymity of the participants will be maintained throughout the study. Students will be assured that their participation is voluntary, and they can withdraw from the study at any time without any negative consequences. This methodology outlines a comprehensive plan to investigate the impact of digital storytelling on numeracy skills development among Primary 2 students in Malaysia. By employing a quantitative data collection method, the study aims to provide a understanding of how digital storytelling can enhance mathematical learning in early primary education.

RESULTS

This chapter presents the findings of the study that investigated the impact of using digital storytelling on the number sense of Primary 2 pupils within 1000. The primary data were collected through pre-test and post-test scores, which were statistically analyzed using a paired t-test. This chapter will discuss the statistical results, interpret the findings in relation to the research questions, and link the outcomes to the existing literature.

The study involved 35 pupils who participated in both the pre-test and post-test assessments. The descriptive statistics for the pre-test and post-test scores are summarized in Table 1 below:

Table 1: Paired Samples Statistics

	N	Mean	Std. Deviation	t	Sig. (Two-sided p)
Pre	35	44.11	22.746		
Post	35	65.17	23.860	-4.788	<.001

The results of the pretest and posttest are shown in Table 1. The results show that the pupils scored a higher mean ($m=65.17$) in the posttest compared to the pretest ($m=44.11$). With a mean difference of 21.06, the results showed a significant improvement in the mean scores from the pretest to the posttest. It appears to be a moderately positive relationship between the two sets of scores. To determine how the intervention affected participants' scores from the pretest to the posttest, a paired t-test was carried out. The paired samples t-test results indicate a significant difference in numeracy scores between the pretest and posttest, $t=-4.788$, $p<0.001$. The improvement in the sample group has indicated the use of digital storytelling had a substantial positive effect on students' numeracy skills. Based on the pretest and posttest, it is found that the digital storytelling was effective in teaching and learning mathematics. The results contribute to the increasing amount of research that shows how effect

digital storytelling can be used as a teaching tool to improve the performance of students. With the approach, students were able to apply mathematical ideas with greater accuracy and confidence, as shown by the observed increase in numeracy scores.

DISCUSSION

The findings of this study provide strong evidence that digital storytelling is an effective tool for enhancing numeracy skills among Primary 2 students. The significant improvements observed in the pre- and post-assessment scores of the experimental group suggest that digital storytelling can make mathematical concepts more accessible and understandable for young learners.

The findings of this study are consistent with the theoretical framework that supports the use of digital storytelling in teaching numeracy. According to the digital storytelling, integrating verbal and visual elements in storytelling can enhance learning by providing dual channels for information processing (Wu & Chen, 2020). In this study, digital storytelling provided a context-rich, narrative-driven approach that likely helped pupils better understand and retain mathematical concepts related to numbers within 1000. Furthermore, the interactive and participatory nature of digital storytelling may have contributed to increased motivation and engagement among the pupils. As noted by Wu & Chen (2020), digital storytelling can create a more dynamic and personalized learning experience, which can be particularly beneficial for young learners who might otherwise find abstract concepts challenging to grasp.

While this study provides valuable insights, it is important to acknowledge its limitations. The sample size was relatively small and limited to a single school, which may affect the generalizability of the findings. Future research should involve larger and more diverse samples to validate these results. Additionally, this study focused on short-term improvements in number sense. Longitudinal studies are needed to examine the long-term effects of digital storytelling on pupils' mathematical abilities and overall academic performance.

CONCLUSION

The results of this quantitative study indicate that digital storytelling is one of the potential tools for enhancing numeracy skills and student engagement in Primary 2 classrooms. By making mathematical concepts more accessible and engaging, digital storytelling has the potential to significantly improve students' learning outcomes. Future research should continue to explore the long-term effects of digital storytelling on numeracy development and identify best practices for its implementation in diverse educational settings.

This study has demonstrated the integration of David Tall's "Three Worlds of Mathematics" framework with digital storytelling and AI-generated adaptive visual content offers a robust framework for enhancing primary pupils' understanding of number sense within 1000. The pre-test and post-test data indicate a significant improvement in students' performance, demonstrating the effectiveness of this approach. By leveraging the Conceptual-Embodied World, pupils build mental images of mathematical concepts through engaging stories and interactive visuals. The Proceptual-Symbolic World transitions these experiences into symbolic representation, allowing students to manipulate numbers and solve arithmetic problems within the narrative context. Finally, the Axiomatic-Formal World helps students develop abstract thinking and logical reasoning through structured challenges and AI-driven interactive proofs. The use of digital storytelling captivates students' attention and makes learning more enjoyable, which is particularly beneficial in mathematics education, where engagement and motivation are critical. AI-generated adaptive visual content ensures that learning experiences are personalized and responsive to each student's needs, providing appropriate challenges and support.

Overall, the integration of these innovative educational tools aligns well with contemporary theories of learning and provides a promising strategy for modernizing mathematics education.

However, several limitations should be acknowledged. The study's sample size was relatively small, and its findings may not be fully generalizable to all primary schools in Malaysia. Additionally, the intervention period was limited to four weeks, and resource constraints may pose challenges to widespread adoption of digital storytelling. Despite these limitations, the study offers important insights and recommendations. Schools should invest in teacher training and technological resources to support the implementation of digital storytelling in mathematics education. Educational policymakers should consider integrating digital storytelling into the curriculum and supporting further research to explore its long-term effects and applicability across different contexts. By addressing these recommendations and limitations, educators can harness the potential of digital storytelling to improve numeracy skills and contribute to enhanced learning outcomes for students in Malaysia and beyond. Future research should continue to explore the specific mechanisms through which these tools impact learning outcomes and identify best practices for their implementation in diverse educational contexts. By embracing digital storytelling and AI, educators can transform mathematics education and help students achieve higher levels of understanding and proficiency.

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