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INVESTIGATING THE EFFICACY OF STORYTELLING APPROACH IN ENHANCING SCIENCE LEARNING AT THE PRIMARY SCHOOL

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Abstract
Storytelling in science education involves inculcating story writing principal elements into making scientific observations and concepts stimulating, thought-provoking, and attractive. this study investigated the use of storytelling approach in enhancing science learning among primary school pupils. A quasi-experimental design was employed, with pre-test, post-test, and retention scores analyzed to assess the impact of storytelling interventions. Results revealed significant improvements in science achievement and retention among students exposed to storytelling, compared to those in control groups receiving traditional instruction. The positive outcomes underscore the potential of storytelling as an effective instructional approach in science education, with implications for educators, curriculum developers, and policymakers aiming to enhance student learning experiences and outcomes.

Keywords: Storytelling; Science education, Primary school, Learning outcomes

Introduction

Science learning in primary education holds profound importance as it serves as the cornerstone for fostering essential skills, knowledge, and attitudes crucial for lifelong scientific literacy and engagement. Through engaging in hands-on exploration, inquiry-based activities, and problem-solving tasks, children not only develop critical thinking skills but also learn to formulate hypotheses, conduct investigations, and draw evidence-based conclusions. This early exposure to science education cultivates a natural curiosity about the world, sparking wonder and excitement about scientific phenomena. Such curiosity lays the foundation for a lifelong interest in learning and exploration, promoting a positive attitude towards science (Darling-Hammond et al., 2020; Hadzigeorgiou, 2012). Additionally, science education in primary school equips children with essential 21st-century skills, such as problem-solving, collaboration, and communication, essential for navigating an increasingly complex and technologically-driven world (Sheikh Abdullah, 2016). Importantly, quality science education can help bridge the equity gap by providing all children, regardless of background or socioeconomic status, with equal opportunities to engage in

meaningful learning experiences. By promoting inclusion and diversity in STEM fields, quality science learning ensures that every child has the chance to pursue their interests and potential careers in science. Ultimately, investing in high-quality science education during the primary school years empowers children to become informed citizens, lifelong learners, and future innovators in the field of science.

Storytelling serves as a powerful pedagogical tool, particularly in the context of science education, offering unique benefits that enhance learning experiences for school-age children. Drawing from research and literature, the role of storytelling in education is multifaceted and instrumental in facilitating meaningful engagement and comprehension of scientific concepts. Numerous studies emphasize the effectiveness of storytelling in education as a means to captivate learners' attention and stimulate their imaginations (Juraid & Ibrahim, 2016; Madondo & Dampier, 2022). In the realm of science education, storytelling transcends the mere transmission of facts by contextualizing scientific concepts within narratives, making abstract ideas more accessible and relatable to young learners (Hadzigeorgiou, 2016; Hadzigeorgiou & Schulz, 2019). By embedding scientific principles within compelling narratives, educators can foster deeper understanding and long-term retention of content (Landrum & Brakke, 2019; Matamit et al., 2020)

Moreover, storytelling promotes the development of critical thinking skills by encouraging children to analyze, synthesize, and interpret information within the narrative framework (Pardede, 2019; Wiwikananda & Susanti, 2022). Through storytelling, learners are actively engaged in sense-making activities, where they construct meaning and make connections between scientific concepts and real-world phenomena (Hadzigeorgiou & Schulz, 2019). This process not only enhances comprehension but also cultivates creativity and problem-solving abilities (Herranen, 2020). Additionally, storytelling facilitates the integration of socio-emotional learning into science education by evoking empathy, compassion, and ethical reasoning (Juraid & Ibrahim, 2016; Landrum & Brakke, 2019). Stories have the power to engage learners on an emotional level, prompting reflection on the ethical implications of scientific advancements and promoting responsible decision-making (Darling-Hammond et al., 2020; Rutledge, 2016). Furthermore, storytelling fosters a sense of cultural relevance and inclusivity by incorporating diverse perspectives and voices into the educational narrative (Gürsoy, 2021; Matamit et al., 2020). Through stories, learners gain exposure to different cultural contexts, traditions, and ways of knowing, fostering intercultural understanding and appreciation (Simeon-Fayomi, 2015).

Storytelling in science education involves inculcating story writing principal elements into making scientific observations and concepts stimulating, thought-provoking, and attractive. It involves using a scientific concept to create a captivating, appealing, and exciting story. Studies have shown that teachers tend to be authoritative figures and dominate most of the teaching of scientific facts (Rutledge, 2016; Wallace et al., 2022). There seems to be a paucity of research on combining storytelling and science in primary school settings (Walan, 2017). Consequently, this study examines the use of storytelling approach in enhancing science learning. Based on the above discussion, the following objectives were raised to (1) determine the effect of storytelling on science achievement in primary school; (2) examine the effect of storytelling on retention ability of scientific concept in primary school. The following hypotheses were generated to guide the

study: Ho_1: The use of storytelling will have a significant effect on science achievement in primary school; Ho_2: Storytelling will significantly enhance the retention ability of scientific concepts in primary school.

Theoretical background

In the realm of education, storytelling encompasses a multifaceted approach to teaching and learning, leveraging narratives to convey information, evoke emotions, and engage learners in meaningful ways. Several scholars have provided definitions that capture the essence of storytelling within an educational context. In a study by James (2017), storytelling in education refers to the deliberate use of oral, written, or visual narratives to convey content, stimulate imagination, and promote comprehension among learners. This definition highlights storytelling as a purposeful pedagogical strategy aimed at enhancing both cognitive and affective aspects of learning.

Similarly, storytelling in education is defined as the process of crafting and sharing narratives to convey knowledge, values, and cultural traditions (Demirci & Okur, 2021; Sari & Hermansyah, 2022; Simeon-Fayomi, 2015). Simeon-Fayomi (2015) emphasizes the cultural and social dimensions of storytelling, highlighting its role in transmitting shared beliefs and experiences across generations. From a cognitive perspective, Landrum and Brakke (2019) and Pardede (2019) describes storytelling in education as a cognitive tool that helps learners construct meaning, make connections, and develop conceptual understanding. This definition underscores storytelling as a cognitive process that facilitates sense-making and knowledge construction. Furthermore, Daniels (2013) define storytelling in education as a dynamic process of creating digital or multimedia narratives to engage learners in interactive and immerse learning experiences. This definition expands the traditional notion of storytelling to encompass digital technologies and multimedia platforms, reflecting the evolving nature of storytelling in the digital age.

Constructivism theory provides a robust theoretical framework for understanding the role of storytelling in science education. According to constructivist principles, learners actively construct their understanding of the world through interactions with their environment, incorporating new knowledge into existing mental frameworks (Bruner, 1961). Storytelling aligns with these principles by providing learners with meaningful narratives that contextualize scientific concepts and facilitate the construction of knowledge through personal reflection and sense-making.

In the context of science education, storytelling serves as a vehicle for learners to explore scientific phenomena within familiar contexts and narratives. By embedding scientific concepts within engaging stories, educators create opportunities for students to connect abstract ideas to real-world experiences, fostering deeper understanding and retention (Hadzigeorgiou, 2016). For example, a story about a fictional scientist's discovery journey can illuminate the scientific method and the process of inquiry, allowing students to vicariously experience the excitement and challenges of scientific exploration. Moreover, storytelling encourages active engagement and participation among learners, as they become co-creators of knowledge through interpretation and reflection

(Rutledge, 2016). By encouraging students to analyze characters, plotlines, and conflicts within scientific narratives, educators promote critical thinking skills and encourage the construction of multiple perspectives on scientific issues (Pardede, 2019). This collaborative sense-making process mirrors the social nature of learning proposed by constructivism, where knowledge is co-constructed through interactions with others (Vygotsky, 1978). Furthermore, constructivism emphasizes the importance of providing authentic and situated learning experiences that are relevant to learners' lives (Applefied et al., 2001). Storytelling enables educators to create rich and immersive learning environments where scientific concepts are situated within meaningful contexts, such as environmental conservation or medical breakthroughs. By connecting science to real-world issues and dilemmas, storytelling promotes motivation and engagement among students, encouraging them to take ownership of their learning and explore scientific concepts beyond the classroom (Hadzigeorgiou, 2016; Kaur, 2020).

Methodology

The study utilized a quasi-experimental design, specifically employing a pre-test-post-test repeated measures design with a control group. The sample consisted of 26 participants aged 8 to 9 years, drawn from two primary schools located in Ado-Ekiti, Ekiti State, Nigeria. These schools were randomly selected from the pool of privately owned schools in Ado-Ekiti. Of the total sample, 14 participants from one intact class were randomly assigned to the experimental group, while 12 participants were assigned to the control group.

The intervention involved two short story sessions with the experimental group, during which two science topics were taught. The two topics include Pollution “The Adventures of Clean-Up Crew: Saving Nature from Pollution” and Rocks “Rocky's Journey: Exploring the World of Rocks” each taught using storytelling techniques. In contrast, the control group received instruction using the conventional teaching method.

To assess the impact of the intervention, the dependent variable of achievement was measured using the "Science Story Achievement Test" (SSAT). This instrument was administered as a pre-test and post-test to gauge the participants' prior knowledge and comprehension levels regarding the subject matter. Additionally, a retention test was administered to both groups two weeks after the intervention to assess the retention of the taught material. The SSAT instrument, utilizing an inter-rater scale, demonstrated a reliability coefficient of 0.86, ensuring consistency and validity in the assessment process.

Results

Ho_1: The use of storytelling will have a significant effect on science achievement in primary school

In testing this hypothesis, the scores obtained were subjected to two levels of analysis to determine the effect of storytelling on science achievement of primary school pupils. The first level of analysis was carried out to test determine the entry-level of the pupils.

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Table 1. T-test Analysis of the Pre-test Score of Experimental and Control Group

	N	Mean	Std. Dev.	T	Sig.
Pretest Experimental group	14	2.00	0.784	2.384	0.135
Control group	12	1.92	0.793		

The findings from table 1 indicate that there is no notable distinction between the pre-test scores of both the experimental and control groups, with $t = 2.384$ and $p > 0.05$. This suggests that all participants, regardless of group assignment, began at a similar baseline level of knowledge.

The subsequent stage of analysis for Hypothesis One aimed to evaluate the impact of the intervention (storytelling) on the science achievement of the students. To explore this, pre-test and post-test scores were analyzed using paired sample tests. Table 2 presents the outcomes of this investigation into the intervention's effectiveness.

Table 2. Paired Samples Test of the Pretest and the Posttest Score of Experimental and Control group

		Mean	Std. Dev	t	df	Sig.
Pair 1	Pre-test experimental group – Post-test experimental group	-4.643	0.745	-23.32	13	0.000
Pair 2	Pre-test control group – Post-test control group	-0.333	1.303	-0.886	11	0.394

Table 2 illustrates the results of the paired sample test conducted on the pre-test and post-test scores of the experimental group. The analysis yielded a significant finding at the 0.05 significance level, with the experimental group exhibiting a t-value of -23.32 and $p < 0.05$. This outcome indicates a

notable impact of storytelling on the science achievement of the students. Consequently, the null hypothesis is rejected, leading to the conclusion that storytelling enhances the academic performance of pupils.

Ho_2: Storytelling will significantly enhance the retention ability of scientific concepts in primary school.

To test this hypothesis, pre-test, post-test, and retention scores of the groups were subjected to one-way repeated measures ANOVA.

Table 3. Descriptive Statistics of Retention Ability Scores

	Mean	Std. Deviation	N
Pre-test experimental group	2.00	0.784	14
Pre-test control group	1.97	0.793	12
Post-test experimental group	6.64	0.929	14
Post-test control group	2.64	0.691	12
Retention experimental group	8.14	0.864	14
Retention control group	2.23	0.773	12

Table 3 presents a comparison of mean scores, standard deviations, and sample sizes for the pre-test, post-test, and retention test scores of both the experimental and control groups. In terms of the pre-test scores, the experimental group displayed a mean score of 2.00, with a standard deviation of 0.784, based on a sample size of 14 participants. Conversely, the control group exhibited a slightly lower mean score of 1.97, with a similar standard deviation of 0.793, derived from a sample size of 12 participants. Moving to the post-test scores, the experimental group demonstrated a noticeable increase in mean score to 6.64, accompanied by a standard deviation of 0.929, with a sample size of 14 participants. On the other hand, the control group's mean score remained lower at 2.64, with a standard deviation of 0.691, based on a sample size of 12 participants. For the retention test scores, the experimental group exhibited a further rise in mean score to 8.14, alongside a standard deviation of 0.864, with a sample size of 14 participants. Similarly, the control group's mean score also decreased to 2.23, with a standard deviation of 0.773, derived from a sample size of 12 participants. Overall, these results indicate a significant

improvement in scores from the pre-test to the post-test and retention test for experimental group. The experimental group consistently displayed higher mean scores across all assessments compared to the control group. This suggests the effectiveness of the storytelling intervention in enhancing science achievement among pupils, as evidenced by their superior mean scores in the post-test and retention test.

Table 4. One-Way Repeated Measures ANOVA table for the effect of storytelling on science concept retention

	Value	**F**	**Hypothesis df**	**Error df**	**Sig.**	**Partial Eta Squared**
Pillai's Trace	1.000	253.901	3	20	.000	0.974
Wilks' Lambda	.000	277.369	3	18	.000	0.982
Hotelling's Trace	9.626	253.901	3	20	.000	0.974
Roy's Largest Root	9.626	253.901	3	20	.000	0.974

The One-Way Repeated Measures ANOVA table reveals a significant impact of storytelling on science concept retention. Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root all demonstrate statistically significant findings ($p < .05$), indicating that storytelling has a substantial effect on the retention of science concepts among the participants. The high values of partial eta squared (ranging from 0.974 to 0.982) suggest a large effect size, underscoring the practical significance of incorporating storytelling as a pedagogical approach to enhance science concept retention. Overall, these results provide strong evidence supporting the efficacy of storytelling in promoting the retention of science concepts among learners.

Table 5. Pairwise Comparisons

(I) experimental group	(J) experimental group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Pre-test	Post-test	-4.643*	.199	.000	-5.073	-4.213
	Retention	-6.143*	.231	.000	-6.642	-5.644
Post-test	Pre-test	4.643*	.199	.000	4.213	5.073
	Retention	-1.500*	.139	.000	-1.800	-1.200
Retention	Pre-test	6.143*	.231	.000	5.644	6.642
	Post-test	1.500*	.139	.000	1.200	1.800

The pairwise comparisons presented in Table 5 offer valuable insights into the differences in mean scores across various assessment points within the experimental group. Firstly, comparing the pre-test scores with the post-test scores reveals a substantial mean difference of -4.643, indicating a significant improvement in science concept retention following the storytelling intervention ($p < .001$). Similarly, when comparing the pre-test scores with the retention scores, a notable mean difference of -6.143 is observed, signifying a significant enhancement in science concept retention from the initial assessment to the retention test subsequent to the storytelling intervention ($p < .001$). Moreover, the comparison between post-test and retention scores shows a mean difference of -1.500, suggesting a significant decrease in scores from the post-test to the retention test ($p < .001$). However, despite this decline, it is evident that a substantial portion of the knowledge gained from storytelling was retained over time. These findings indicate that storytelling had a positive and statistically significant impact on science concept retention among the participants. While there was a slight decrease in retention scores over time, the overall improvement observed from the pre-test to both the post-test and retention test underscores the effectiveness of storytelling as a pedagogical tool in facilitating long-term retention of science concepts.

Discussion

The findings of this study provide insights into the impact of storytelling on science achievement in primary school. Initially, the analysis focused on determining the entry level of the participants, which revealed no significant difference between the pre-test scores of the experimental and control groups. This suggests that both groups commenced the study with comparable levels of understanding, ensuring a balanced comparison between the effects of storytelling intervention.

Subsequently, the investigation delved into the effect of storytelling intervention on science achievement, utilizing pre-test and post-test scores subjected to paired sample tests. The results, as depicted in Table 2, unveil a significant difference in the pre-test-post-test scores of the experimental group, with a t-value of -23.32 and $p < 0.05$. Conversely, the control group exhibited non-significant changes in scores, indicating minimal improvement in science achievement. These findings align with prior research emphasizing the efficacy of storytelling as a pedagogical tool to enhance learning outcomes in various educational contexts. Storytelling has been shown to enhance learning, engage students, stimulate critical thinking, and foster deep understanding (Juraid & Ibrahim, 2016; Landrum & Brakke, 2019; Madondo & Dampier, 2022). By integrating storytelling into science education, educators can effectively convey complex concepts in an accessible and engaging manner, catering to diverse learning styles (Rutledge, 2016)

Moreover, the significant improvement observed in the experimental group underscores the potential of storytelling to foster a deeper understanding of scientific concepts among primary school pupils. Storytelling not only promotes academic achievement but also cultivates a sense of curiosity and enthusiasm for learning, essential for lifelong learning and academic success (Darling-Hammond et al., 2020; Hadzigeorgiou, 2012). The rejection of the null hypothesis signifies the positive impact of storytelling on science achievement in childhood education. Embracing storytelling as a pedagogical approach holds promise for educators seeking innovative methods to enhance learning experiences and empower students to thrive in science disciplines.

The findings of this study shed light on the role of storytelling in enhancing the retention ability of scientific concepts among primary school students. The hypothesis, which posited that storytelling significantly improves science concept retention, was rigorously examined through a series of analyses. The descriptive statistics presented in Table 3 offer valuable insights into the distribution of scores across different assessment points for both the experimental and control groups. Notably, the experimental group exhibited consistently higher mean scores across all assessments, indicating a notable improvement in science concept retention following the storytelling intervention. This trend is particularly evident in the post-test and retention test scores, where the experimental group outperformed the control group by a significant margin.

Further bolstering these findings, the One-Way Repeated Measures ANOVA table provides compelling evidence of the significant impact of storytelling on science concept retention. The findings yielded statistically significant results, underscoring the substantial effect of storytelling on enhancing the retention of scientific concepts among participants. The large effect sizes, as indicated by the high values of partial eta squared, emphasize the practical significance of incorporating storytelling as a pedagogical approach to bolster science concept retention. The pairwise comparisons presented in the result offer a nuanced understanding of the differences in mean scores across various assessment points within the experimental group. Significantly, the comparisons reveal substantial mean differences between pre-test and post-test scores, as well as between pre-test and retention scores, indicating a significant improvement in science concept retention following the storytelling intervention. Although a slight decrease in retention scores is observed when comparing post-test and retention scores, the overall improvement from the pre-test to both the post-test and retention test underscores the effectiveness of storytelling in facilitating long-term retention of scientific concepts. These findings align with prior research highlighting the efficacy of storytelling as a pedagogical tool in promoting meaningful learning experiences and fostering knowledge retention among learners (Landrum & Brakke, 2019; Matamit et al., 2020). By engaging students in narrative-driven learning activities, educators can create immersive learning environments that stimulate curiosity, enhance comprehension, and promote knowledge retention (Hadzigeorgiou, 2016). Ultimately, the results of this study underscore the importance of integrating storytelling into educational practices to optimize learning outcomes and empower students to succeed in their academic pursuits.

Conclusion and Recommendations

In conclusion, this study has provided empirical evidence supporting the effectiveness of storytelling as a pedagogical tool for enhancing science concept retention among primary school students. The findings indicate that storytelling interventions led to significant improvements in students' science achievement and retention abilities compared to traditional instructional methods. By engaging students in narrative-based learning experiences, educators can create meaningful contexts for understanding scientific concepts and foster long-term retention of knowledge. These results underscore the importance of incorporating storytelling into educational practices to promote active engagement, critical thinking, and knowledge retention among students. However, it is essential to recognize the limitations of this study, including the small sample size and short intervention duration, which may impact the generalizability of findings. Nonetheless, the positive

outcomes observed in this study highlight the potential of storytelling as a valuable instructional approach in science education.

Based on the findings of this study, recommendations can be made to educators, curriculum developers, and policymakers. Firstly, educators should consider integrating storytelling into their instructional practices to enhance student engagement and facilitate deeper understanding of scientific concepts. By incorporating narrative-based activities, such as storytelling sessions and role-playing exercises educators can create dynamic learning experiences that appeal to diverse learning styles and promote active participation. Additionally, curriculum developers should explore opportunities to embed storytelling into science curricula at both primary and secondary levels. By incorporating storytelling elements into lesson plans and educational materials, curriculum developers can enrich learning experiences and help students develop a deeper appreciation for science. Furthermore, policymakers should support initiatives aimed at promoting innovative teaching methods, including storytelling, in educational settings. By investing in professional development programs and providing resources for educators to implement storytelling-based interventions, policymakers can support the widespread adoption of effective instructional practices that enhance student learning outcomes. The integration of storytelling into science education holds tremendous potential for improving student engagement, comprehension, and retention of scientific concepts, thereby contributing to the development of a scientifically literate society.

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