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The Effect of "Eclice" an Educational Media on Science Literacy Among 5-6 Year-Old Children in Sado, Thailand

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ABSTRACT

Climate change is a global issue that is imperative to introduce to children from an early age so that they develop adequate science literacy to understand and respond to its impact. This study aimed to develop eclice media as an e-book on climate change to enhance the science literacy of children aged five to six. The research method employed the pre-experimental design one group pretest and post-test, with the subject being 20 children aged 5-6 years at Sadao Kindergarten Thailand. The instruments utilized included questionnaires, observations, and science literacy tests. The effectiveness of the media was determined by analysing the data using the Wilcoxon test. The findings indicated that the use of eclice media was both practical (100% feasibility) and led to a substantial enhancement in children's science literacy ($p < 0.05$). The research findings suggest that eclice can serve as an alternative to innovative learning media, aiming to foster science literacy from an early age and enhance the role of teachers and parents in environmental education.

INTRODUCTION

Science literacy is the capacity to comprehend, assess, and apply scientific knowledge to make informed decisions and engage in critical thinking in daily life. Science literacy integrates two components: understanding scientific concepts and applying science in the real world (Osborne, 2023). Science literacy can also be defined as the ability to recognize, be aware of, and care about the surrounding environment so that people can protect the environment and solve problems around them (Kumar et al., 2023). The concept of science literacy has existed since the 1900s, with its reintroduction to the educational sphere by Paul Dehart Hurd in 1958 in a school in the United States (Rudolph, 2024). According to Lederman et al. (2023), science literacy is defined as the ability to identify, understand, and use scientific knowledge to formulate questions and make decisions that can be substantiated. Science literacy is having in-depth knowledge of science and applying it to one's life (Valladares, 2021). Based on this definition, science literacy can be described as the ability to understand and apply scientific principles in everyday life. Children need to apply science literacy in everyday life. It will be highly beneficial for children and continue into adulthood. They will find it easier to understand scientific phenomena and adapt to environmental changes.

According to Handayani and Srinahyanti (2018), the concept of early childhood science literacy encompasses the process of introducing the environment to direct introduction. Developing science literacy skills entails observing, classifying, comparing, measuring, and communicating children's observations and experiences (Zahrotin et al., 2022). This process can cultivate children's curiosity and foster the development of a scientific mindset from an early age. A scientific mindset fosters an

environment conducive to experimental learning, where children are encouraged to engage with and explore natural phenomena. This mindset is paramount in fostering children's capacity for self-sufficiency and adaptability in an ever-evolving environment (Fenny Muldiani et al., 2018). Science has numerous connections to children's lives, thus making science literacy development and nurturing from an early age a critical endeavor. Science literacy is particularly important for young children, as this skill is a foundational element in children's critical thinking development (Campbell & Howitt, 2024). It is an inherent aspect of child development that they spontaneously engage with, observe, and acquire knowledge from scientific objects in their immediate environment. Scientific literacy is the ability to recognize, understand, and take action regarding environmental issues, fostering the development of environmental stewardship and problem-solving skills in children. The cultivation of scientific literacy in children has been demonstrated to facilitate enhanced comprehension of the phenomena that surround them, promote creativity in problem-solving, and generate a heightened interest in scientific disciplines. Science literacy instruction has fostered scientific thinking in children, equipping them with the cognitive tools necessary to address future challenges (Olusanya et al., 2022).

Since 2006, there has been a persistent decline in science literacy levels among adults and children, particularly in Thailand (Thummathong & Thathong, 2018). According to the results of a survey administered by the OECD (2019) through the Program for International Student Assessment (PISA), Thailand exhibits a substandard level of science literacy. This finding suggests that Thai children's science literacy remains deficient. Researchers' observations in the field demonstrate that children's science literacy levels are suboptimal, particularly in the absence of adequate infrastructure and the underutilization of technology to enhance children's science literacy. Furthermore, promoting science literacy is frequently not a priority in early childhood education (ECE). Cultivating critical thinking, communication, cooperation, and positive attitudes toward science should be the focal point of early childhood science literacy (Fortus et al., 2022). The educational curriculum in Thailand incorporates scientific instruction that fosters the development of science literacy among children. The 2008 Basic Education Core Curriculum, also called the Basic Education Core Curriculum 2008, is the national curriculum currently employed in Thailand. This curriculum represents a refinement of the 2001 curriculum, a revision to address the shortcomings in implementing the previous curriculum (Astri Azani et al., 2024).

Yuenyong (2013) posits that the prevailing approach to science literacy education necessitates modification, as educators often lack a comprehensive grasp of the concept of science literacy, and the integration of science in the curriculum remains superficial. Consequently, the science literacy of children in Thailand remains suboptimal. This finding aligns with the results of a study conducted by researchers at Tessaban 1 Bansadao Kindergarten in Thailand. The researchers observed the kindergarten at that time. They found that teachers only mentioned the weather and disasters without explaining the causes or effects of natural phenomena such as floods or climate change. The pedagogical approach employed by the instructors was conventional, utilizing flashcards and visual aids on the classroom wall.

In contrast, the students required authentic, experiential learning opportunities to comprehend critical concepts, particularly those about climate change. This was achieved through multimedia resources, such as animated films, news reports, and hands-on experiments. The climate change phenomenon has emerged as a subject of global discourse, primarily due to its profound and long-term ramifications. Consequently, the researcher advocates for modifications in science education to cultivate children's science literacy by incorporating more interactive media, offering introductions, cause-and-effect explanations, and solutions to climate change phenomena.

Research by Hafiza et al. (2024) indicates that various learning media, including print, audio, visual, and audiovisual formats, can facilitate children's comprehension of fundamental concepts while engaging in play. The importance of interactive media in maintaining children's interest during the learning process is well-documented. Interactive media has been shown to make learning fun and valuable, which is a critical component of effective pedagogy. While books are frequently utilized, incorporating more interactive materials could enhance children's physical engagement, as evidenced by the studies conducted by Veronica et al. (2021). Nonetheless, as time progresses, children are increasingly drawn to technology. In response to this trend, researchers have developed the eclice media.

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The Eclice e-book, which focuses on climate change, serves as the primary medium for this study. Eclice is an e-book with a climate change theme that recounts the narrative of a polar bear named Boni, who has been displaced from his habitat due to climate change. The language and material employed have been adapted to align with the literacy development of children aged five to six years.

Several studies have previously examined the efficacy of various learning media in enhancing science literacy among children aged 5-6 years. These studies include the storytelling method using a series of pictures by Purwasi & Yuliariatiningsih (2018), the educational game application Wordwall by Aini et al. (2023), the big book media by Setiyaningsih & Syamsudin (2019), and the weather-themed e-book by Oktavia et al. (2024). Despite the shared outcome variable of early childhood science literacy, these studies diverge in utilizing independent variables and methodological approaches. The thematic content and media employed also exhibit variability, encompassing picture books, educational games, big books, and e-books with more universally applicable themes such as weather.

In contrast to previous studies, this research developed an interactive e-book on climate change for children aged 5-6. The e-book incorporates multimedia features such as animation, audio narration, and interactive activities such as games and simple experiments. The novelty of this study lies in its focus on the more specific and complex theme of climate change, interactive features that enhance children's engagement and understanding, and a personalized learning approach that adapts content to children's abilities and interests. Furthermore, this study assesses the influence of media on children's attitudes and awareness concerning climate change issues, thus offering an innovative contribution to the development of science literacy media for young children that is pertinent to contemporary global environmental concerns.

This study aims to enhance the science literacy of children aged 5 to 6 years by developing e-book media. In this book, children are instructed in the principles of climate change, including its characteristics, causes, and effects. The text also guides how children can reduce and anticipate the impacts of climate change. The utilization of creative media has been demonstrated to facilitate children's comprehension of climate change. The advent of electronic media has been identified as a catalyst for enhancing children's interest and comprehension of scientific concepts and environmental concerns. Furthermore, integrating visual appeal and interactivity in e-books can facilitate children's comprehension of scientific concepts and cultivate an early appreciation for environmental stewardship. This innovative learning media has enhanced children's comprehension while imparting the capacity to engage in scientific thinking. A substantial corpus of research has been dedicated to the study of literacy; however, the extant literature on children's science literacy is scant, particularly about the development of e-book as a medium for science literacy education.

METHOD

The present study employed a pre-experimental design of the one-group pretest-post-test type (initial and final testing on one group) to evaluate the effectiveness of e-books on climate change. One group Pretest Post-test design is a form of research that involves administering an initial test (pretest) prior to treatment administration and a final test (post-test) following the treatment administration to one group. The subjects of this study were one class of 20 children from Tessaban 1 Bansadao School in Thailand, who participated in the field testing phase of the study. The subjects were administered a test that employed the eclice media, which was an electronic book on climate change. This e-book has been validated by several experts in the field of early childhood education, including teachers from Tessaban 1 Bansadao School in Thailand. A small-scale experiment was also conducted on 10 children from the same kindergarten but from different classes. The data collection instruments employed in this study functioned as a measuring tool or guideline, the purpose of which was to collect data that would subsequently be analyzed in order to validate the climate-themed e-book that had been developed. The data collection process for this study involved the administration of questionnaires and surveys by experts in the field of judgment. The participating experts included a teacher at Tessaban 1 Bansadao Kindergarten in Thailand, who possesses expertise in educational media and science literacy, particularly in climate change education for children aged 5-6.

The effectiveness of climate change-themed ebooks for children aged 5-6 years was assessed using data obtained from observation instruments. Researchers will utilize observation sheets to

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ascertain the efficacy of e-book in enhancing the science literacy of children aged 5-6 years. Researchers will also assess children's science literacy before and after the treatment. In this study, observation sheets are intended to record children's learning objectives and evaluate their interactions with the media. The scale utilized in this study for the pretest and post-test observation sheets offers four options, namely: The developmental stage of the subject has been determined as follows: "Not Yet Developed" (BB), "Beginning to Develop" (MB), "Developing as Expected" (BSH), and "Developing Very Well" (BSB). The following table contains the instrument grid adapted from the PISA.

Tabel 1. Science Literacy Instrument Guidelines

Aspects	Indicators	Number of Item	Item
Science Content	Children are able to recognize climate change	1	1
Science Process	Children are able to identify climate change.	1	1
Science Context	Children are able to apply scientific skills in everyday life.	1	1

Table 1 presents a set of indicators that will serve as guidelines for conducting observations based on the science literacy abilities of children aged 5-6 years. Regarding the scientific content, the children will be administered a test that will be a matching exercise. The test will feature images of climate change phenomena, such as damaged and well-maintained earth conditions. In the scientific method component, students will be administered a test requiring them to connect images related to the causes and effects of climate change phenomena. Within the scientific framework, children will be administered a test that will take the form of a matching exercise involving images depicting the consequences of climate change phenomena and strategies for mitigating their impact.

The data analysis technique employed in this study was nonparametric statistical analysis. The utilization of nonparametric statistical analysis was necessitated by the observation that the data sample obtained exhibited a non-normal distribution. This assessment was conducted by implementing the Shapiro-Wilk test, a statistical procedure employed to evaluate the normality of a data sample with a limited sample size, in this case, 20 children. According to Adriani (2024) in her journal, if the sample size is less than 50, the Shapiro-Wilk normality test should be used. Nonparametric statistical analysis was employed with the Wilcoxon matched paired test due to its suitability for assessing significance in a single sample group (Nowak et al., 2022). The effectiveness analysis employed in this study was utilized to examine the outcomes of the children's pretest and post-test in science literacy—the children's pretest-post-test results were analyzed through the N-gain average.

RESULTS AND DISSCUSSION

The Eclice media, in the form of an e-book with a climate change theme, has proven to be an effective learning tool for improving the science literacy of five- and six-year-old children. The effectiveness test results for this media were obtained through research observations conducted over three weeks in September 2024, including pretest, treatment, and post-test. The study took place in the MEP 2 class at Tessaban 1 Sadao Kindergarten in Thailand and included 20 children. The pretest and post-test results showed increased knowledge before and after the treatment with the e-book, as illustrated in Figure 1. Thus, the e-book had an effect. Here the media used in this research (https://drive.google.com/file/d/1LLJROGhO_KIJC5JO_l4bX6hBEWUtdHh8/view?usp=drive_link).

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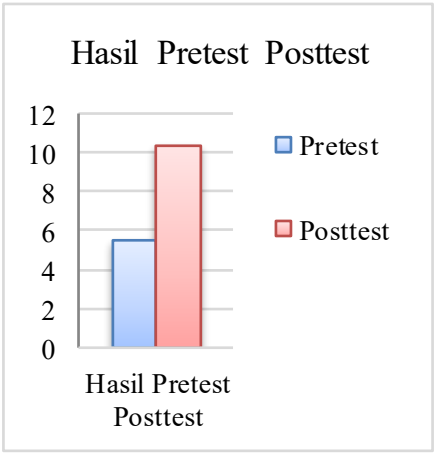

Figure 1. Pretest Post-test Results

Figure 1 illustrates the observed increase in performance metrics between the pre-and post-treatment phases, with the latter corresponding to the implementation of e-learning media. The preliminary results indicated a score of 5.55, which falls within the Starting to Develop (MB) category. In contrast, the post-test results demonstrated a score of 10.4, categorizing it as Developing as Expected (BSH). An efficacy analysis employing prerequisite tests and statistical analyses is imperative to substantiate these findings. Under the data, normality and homogeneity tests can be performed. The ensuing table delineates the normality test decision. The data is not normally distributed, as indicated by a significance level of less than 0.05. The data is considered to be normally distributed if the significance is greater than 0.05.

Tabel 2. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Test Result	Pretest	.293	20	.000	.902	20	.045
	Post-test	.264	20	.001	.813	20	.001

a. Lilliefors Significance Correction

The normality test results in Table 2 indicate that the data sample is not normally distributed because the significance value is 0.045, which is less than 0.05. Consequently, the null hypothesis (Ho) is rejected, and the alternative hypothesis (H1) is accepted. Following the assessment of normality, a homogeneity test was conducted, yielding the following table and decision criteria for homogeneity: If the p-value is less than 0.05, it can be deduced that the data is not homogeneous. The data is considered homogeneous if the significance is greater than 0.05.

Tabel 3. Homogenity Test Results

		Levene Statistic	df1	df2	Sig.
Hasil Test	Based on Mean	1.770	1	38	.191
	Based on Median	1.541	1	38	.222
	Based on Median and with adjusted df	1.541	1	37.764	.222
	Based on trimmed mean	1.623	1	38	.210

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The homogeneity test results in Table 3 show a significance value of 0.191, greater than 0.05. This indicates that the data samples are normally distributed and have equivalent data variation. After determining the outcomes of the normality and homogeneity assessments, the subsequent step is to test the statistics utilizing nonparametric statistical analysis in the form of a Wilcoxon-matched paired Test. The effectiveness analysis employed in this study was utilized to examine the outcomes of the children's pretest and post-test in science literacy. The analysis of the effectiveness of the children's pretest and post-test can be calculated using the N-gain average formula. The results of the N-Gain test, which are based on the results of the pretest and post-test, inform the decision regarding whether If G ≥ 0.7, the High-G category is applicable. It has been determined that 0.7 > g ≥ 0.3 falls under the medium-g criterion. According to the established criteria, values less than 0.3 fall under the low-G category.

Tabel 4. N-Gain Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
Hasil_NGain	20	.33	1.00	.7878	.22631
Hasil_NGain_Persen	20	33	100	78.78	22.631
Valid N (listwise)	20				

Table 4 shows that the G result is 0.7878, above 0.7. This indicates that the criterion is high and can be considered effective. Next is the nonparametric Wilcoxon test, which is useful for determining if the decision is influenced by

If Z < 0.05, then H0 is rejected and H1 is accepted.
If Z > 0.05, then H0 is accepted and H1 is rejected.

Tabel 5. Non-Parametric Wilcoxon Test Results

Test Statistics[a]

Z	-3.968[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Under the findings enumerated in Table 5, the value is determined to be 0, which is less than 0.05. This finding indicates that H0 is rejected and H1 is accepted. Specifically, H0 posits no distinction between children's science literacy skills before and after utilizing the eclice media. At the same time, H1 suggests a distinction between children's science literacy skills before and after employing the eclice media.

The integration of technology in the learning process constitutes a contemporary pedagogical strategy. The development of an e-book on the theme of climate change has the potential to enhance children's awareness and understanding of natural phenomena. Creating Eclice media for children aged 5-6 years employs a scientific approach consistent with the prevailing education curriculum. This approach aligns with the findings reported by Asfiyah et al. (2020), who emphasize the necessity of incorporating science lessons into the curriculum. The creation of ecclesiastical media was not an immediate process; it underwent a series of stages and evaluations.

Quantitatively, the efficacy of e-learning media was demonstrated by a substantial increase in post-test scores relative to pretest scores and elevated N-gain results. The Wilcoxon test demonstrated a substantial discrepancy between the pretest and post-test results, substantiating the hypothesis that electronic media is pivotal in enhancing children's science literacy. Despite the absence of normal distribution in the pretest and post-test data, the homogeneity test indicated uniform variance, thereby enabling the utilization of non-parametric analysis. These results align with the findings of Karakoç Öztürk (2021) and Sun & Pan (2021), who concluded that e-books are effective for delivering complex material to early childhood, particularly through the engaging features of e-books, such as narrative sounds, interactive games, and simple experiments.

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The findings indicate that the eclice media is a recommended innovative and effective learning media for introducing climate change concepts early. In addition to its ease of use and appeal to children, this media has been empirically demonstrated to enhance children's understanding and science literacy at ages 5–6. Many studies have demonstrated that implementing interactive e-books with multimedia components constitutes a suitable pedagogical approach for early childhood science education in the digital era.

CONCLUSION

The eclice media, in the form of an electronic book on climate change, has been proven valid, practical, and effective in improving the science literacy of children aged 5–6 years. The validation results indicated a high degree of feasibility, eliminating the necessity for revision. The Cronbach's alpha reliability test also demonstrated the instrument's excellent consistency. The program's practicality was highly regarded by teachers, who noted its ease of use, interactivity, and the program's capacity to engage children. The efficacy of the media is substantiated by substantial enhancements in pretest and post-test results, as well as elevated N-gain scores. This media is recommended for widespread use in schools and homes, and it can be further developed by adding additional content and interactive features. Some options for expansion include adding content on other environmental topics and enhancing interactive features, such as educational games and animations, to make the media more engaging and educational for children.

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