International Journal of Learning, Teaching and Educational Research
Vol. 24, No. 3, pp. 500-516, March 2025
https://doi.org/10.26803/ijlter.24.3.24
Received Jan 31, 2025; Revised Mar 1, 2025; Accepted Mar 11, 2025

Understanding Kindergarten Teachers' Readiness and Acceptance of STEAM-Oriented Interactive E-Books for English Vocabulary Instruction

Rismareni Pransiska*
Universitas Negeri Padang, Padang, Indonesia

Yenni Rozimela
Universitas Negeri Padang, Padang, Indonesia

Hadiyanto Hadiyanto
Universitas Negeri Padang, Padang, Indonesia

Abstract. The purpose of this study was to assess preschool teachers' willingness and readiness to use a Science, Technology, Engineering, Arts, and Mathematics (STEAM)-based interactive e-book for teaching English vocabulary. This study employed a survey design, utilizing a questionnaire for data collection. There were 150 kindergarten teachers as participants of the study. Participants were selected using stratified random sampling, ensuring representation from both urban and suburban schools across West Sumatra, Indonesia. This approach allowed for balanced demographic representation in terms of age, teaching experience, and educational background. Data analysis involved ANOVA as well as regression tests. The study results indicated that while teachers generally accepted STEAM-based e-books, their readiness varied significantly by education level. Teachers who had qualified up to Bachelor's and Master's degrees were relatively better placed in terms of readiness and acceptance towards the e-books as compared to their Diploma counterparts. However, age did not significantly contribute to these factors. Achieving such an integration requires systematic professional development and training programs. Furthermore, the study also provides opportunities for the effective design of interactive STEAM-based e-books targeted at the introduction of English vocabulary to kindergarten children.

Keywords: preschool teachers; STEAM-based e-books; English vocabulary; Professional Development; training program

*Corresponding author: *Rismareni Pransiska, pransiskaunp@fip.unp.ac.id*

1. Introduction

The increasing global mobility and demand for multilingual competence have influenced early childhood education policies, emphasizing the importance of early English instruction (Gultom, 2015; Huang & Liao, 2021). With increasing globalization, a growing number of people study and work abroad. The need for the mastery of foreign languages, especially English, has been increasing. This does not only apply to adults, but includes children. Children benefit from foreign language instruction starting at an early age. Preschool is important because this is the period when children increase their vocabulary, language comprehension, and basic language skills rapidly (Huang & Liao, 2021). Therefore, English learning should begin early, allowing children to actively participate in the learning process and achieve optimal language development.

Children's participation in activities such as social interaction, communication and cognitive tasks can be improved when they add STEAM in preschool education (Luen et al., 2024). It is further stated that participation in STEAM projects encourages children to discuss and share possible vocabulary ideas, which helps enhance their vocabulary (Nho et al., 2024). So, children who always participate in STEAM activities will be able to improve their language skills as they are involved in discussions while practicing this vocabulary. It is worth noting that children actively participate in these activities and explain themselves so that they develop an opportunity to learn new languages, including English. This strategy enables kindergarten children to develop effective communication skills in English, supported by STEAM-related activities.

The effectiveness of this method is further enhanced when it is noted that children can learn English vocabulary with ease through the use of realia and when they physically engage in the activity. Inherent in project-based learning is the hands-on approach that is characteristic of STEAM, and this, as Marín-Marín et al. (2021) point out, is ideal for kindergarten children as it focuses on activity. Because of this, kindergarten children acquire the additional use of language, including English vocabulary, through abstraction as they interact with concrete materials, i.e., see, touch, and play with them (Breive, 2022). This is also consistent with the principles of Community Language Learning (CLL), where language is taught in an authentic context and connects with the learners' immediate environment. Language can be easily learned and remembered by kindergarten children when it is embedded in a concrete context in their world. This methodology effectively supports preschool children in their linguistic and cognitive development, providing realistic learning contexts for language acquisition (Nara & Kumar, 2024). To strengthen the theoretical foundation of this study, contemporary theories on technology adoption in early childhood education have been integrated. The Technology Acceptance Model (TAM) (Davis, 1989) and the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) provide insights into how teachers perceive and incorporate technology into their teaching practices. In addition, recent studies on STEAM-based learning highlight the cognitive and linguistic benefits of integrating digital tools in preschool instruction (Marín-Marín et al., 2021; Nara & Kumar, 2024).

Research has shown that STEAM and Contextual Language Learning (CLL) methods are complementary (Avargil et al., 2012). It is also necessary to note that STEAM pushes for learning by doing or learning by engaging in projects in which children are made to use actual objects, a concept that is central to CLL. CLL has also sought to ensure that the meaning students gain is best conceptualized in association with real objects; it is clear how CLL fits in with STEAM education, broadening the scope to science, technology, engineering, arts, and mathematics (Tanabashi, 2021). STEAM-influenced vocabulary learning enables children to work with real things and in real situations by engaging in and doing STEAM projects. This integration of STEAM allows children to engage with objects physically and associate them with English vocabulary, enhancing their understanding. Studies have shown that STEAM activities can lead to vocabulary learning as children are encouraged to speak and work on problem-solving tasks (Marín-Marín et al., 2021; Nho et al., 2024).

Even with the availability of STEAM-based teaching materials that will assist in English language learning for kindergarten children, studies have revealed that other challenges still abound in Indonesia regarding adequate provision of English resources (Gultom, 2015). Ironically, teachers often resort to gathering materials from the internet and creating their teaching aids (Muslaini et al., 2018). Unfortunately, this process often ends up generating nonsensical teaching resources that are not suitable for classroom use (Winola, 2021). Many of these resources are not age-appropriate for kindergarten children and do not consider the natural process of language acquisition. This disconnect indicates a gap that must be addressed through age-appropriate STEAM methodological approaches (Syathroh et al., 2019).

The incorporation of interactive e-books in the curriculum as teaching materials, which could then serve as a holistic tool for the teachers in preschool English teaching, is also among the alternative strategies to sustain the existing market culture where the resources are expected to be of high standard and developmentally suitable (Kassabolat et al., 2020). These e-textbooks offer more than just text and pictures: they incorporate videos, audio, graphics, and practical activities that promote an active and engaging learning environment. These features help teachers introduce new words and cultural ideas in a simple and engaging way, making complex topics easier for young learners to understand. Similarly, these e-books use different technologies to present content in a gradual manner, offer interactive activities, and include tools to track student progress. At the same time, this allows teachers to adapt the learning materials in a lesson to match the needs of their classroom and ensure that the content is suitable for preschool children (Mardhiyah & Priyatama, 2023).

Before developing e-book teaching materials, it is essential to assess teachers' readiness and competence in understanding and utilizing these resources. Interactive e-books enhance vocabulary learning by providing multimodal inputs, including text, images and audio, which facilitate comprehension and retention (Breive, 2022). It embodies teachers' technology access, their competencies in STEAM fields, and how they factor it into teaching. The competence of teachers, who are the backbone of all learning models, is equally important, especially in

using and implementing e-book-based learning with appropriate methods for early childhood (Harmanto et al., 2021). This readiness and competency milestone is vital, as teachers are responsible for ensuring that STEAM-based e-books have been appropriately incorporated. Even with all these advantages, the use of e-books may not be enough to help children if teachers themselves are ill-equipped or unskilled and need to be coached properly to optimally use the benefits for achieving their learning targets.

Despite the increasing integration of technology in early childhood education, kindergarten teachers faced significant challenges in adopting STEAM-based e-books for English vocabulary instruction. Limited technological readiness, the lack of adequate training, and insufficient institutional support hinder effective implementation. This study aimed to address these gaps by examining teachers' acceptance and readiness to use STEAM-based e-books, providing insights into necessary interventions for successful adoption.

This study examined kindergarten teachers' readiness and acceptance of STEAM-oriented interactive e-books for English vocabulary instruction. By identifying key factors influencing adoption, this research enhances our understanding of technology integration in early childhood education. Many preschool teachers rely on online materials that lack age-appropriate content or pedagogical structure, resulting in ineffective teaching resources that fail to align with early childhood learning principles (Muslaini et al., 2018). Teachers' technological preparedness, their acceptance of STEAM-themed e-books, and the introduction of e-books into their practice were all examined in this research. In addition, the research addressed the barriers that teachers face when using e-books and the types of training or support that were needed to improve the use of these tools. To accomplish these objectives, the research endeavored to validate that teachers were ready and willing to harness the potential of STEAM-oriented electronic books toward the successful acquisition of the English language by kindergarten children (ages 3-6).

2. Method

2.1 Participants

The study was conducted in early childhood education centers in West Sumatra, Indonesia, encompassing both urban and suburban areas. A total of 150 preschool teachers participated, with 80 teachers from urban schools and 70 from suburban schools. The selected schools represented diverse educational settings, ensuring a balanced sample reflecting different teaching environments.

To enhance the clarity of our methodology, we have provided additional details on participant selection, specifying the stratified random sampling method used to ensure representativeness. Furthermore, we have provided a detailed description of the research design, including a comprehensive explanation of the integration of the Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK) framework (Li et al., 2022; Sánchez-Prieto et al., 2017). The instrumentation section details the development process of the questionnaire, its validation steps, and the rationale behind the selected constructs (Hughes et al., 2021; Rahayu et al., 2022). In addition, the data analysis

section has been refined to explicitly outline the statistical tests applied, ensuring transparency in interpreting the findings (Ruiz-Palmero et al., 2023).

To improve clarity, the sample distribution and demographic data are presented in Table 1 to show the breakdown of participants based on location, age, and educational background.

Table 1: Sample Distribution by Location, Age, and Educational Background

Category	Subcategory	n	%
Location	Urban	80	53.3
	Suburban	70	46.7
Age Group (years)	23-29	35	23.3
	30-39	45	30.0
	40-49	40	26.7
	50+	30	20.0
Educational Background	Diploma	45	30.0
	Bachelor's Degree	85	56.7
	Master's Degree	20	13.3

Table 1 provides a detailed summary of the respondents' demographics, categorizing them by age group and education level. This breakdown offers insights into the distribution of participants and their background characteristics, which were essential for understanding the study's findings. The study used a stratified random sampling method to recruit preschool teachers (N = 150) from 25 early childhood education centers across urban and suburban areas. The sample size was determined through G*Power analysis ($\alpha = .05$, power = .80, medium effect size $f = 0.25$), indicating a minimum requirement of 128 participants, with an additional 15% included to account for potential attrition (Sommet et al., 2023). Teachers in the study ranged in age from 23 to 55 years ($M = 34.2$, $SD = 7.8$), with teaching experience spanning from 2 to 25 years ($M = 8.5$, $SD = 5.3$). Among the participants, 30% held diplomas (n = 45), 56.7% held Bachelor's degrees (n = 85), and 13.3% held master's degrees (n = 20). All teachers selected for the study met three essential criteria: active employment in teaching preschool children aged 3-6 years, a minimum of two years' teaching experience, and demonstrated basic technological literacy.

2.2 Research *Design*

This study used a cross-sectional survey design to examine teachers' acceptance and readiness to implement STEAM-based e-books for vocabulary instruction. The research framework integrated two theoretical foundations: the TAM, which provided insights into teachers' technology adoption processes, and the TPACK framework, which guided our understanding of teachers' knowledge requirements for effective technology integration. This dual theoretical approach enabled a comprehensive examination of both the psychological and pedagogical aspects of STEAM-based e-book implementation.

2.3 Instrumentation

The study used a custom-designed questionnaire to measure teacher acceptance and readiness regarding STEAM-based e-books for teaching vocabulary to 3- to 6-year-old preschoolers. The development process involved a systematic review of literature on educational technology acceptance, followed by item pool generation based on validated instruments in the field. The final questionnaire comprised 14 items using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), organized into two main constructs. The teacher acceptance construct (6 items) assessed perceived usefulness, attitudes toward technology, and intention to use, focusing on teachers' perceptions of STEAM-based e-books' potential to enhance vocabulary instruction. The teacher readiness construct (8 items) evaluated technical readiness, pedagogical readiness, and training experience, examining teachers' preparedness to implement these tools effectively in their classroom practice. This questionnaire included 14 instruments, which were classified into two main variables: teacher acceptance and teacher readiness.

The questionnaire's validity was established through expert review and content validation, ensuring alignment with research objectives. In addition, a pilot study was conducted with 30 preschool teachers to assess clarity and relevance. Reliability was measured using Cronbach's alpha, with values above 0.80, indicating a high level of internal consistency.

2.4 Data Collection Procedure

Data collection spanned three months from January through March 2024, following the institutional review board approval. The process began with securing permissions from participating schools, followed by obtaining informed consent from teachers after a thorough explanation of the study objectives. Questionnaires were administered via a secure online platform, with follow-up reminders sent after one week to ensure optimal response rates.

2.5 Data Analysis

Data analysis followed a systematic approach combining descriptive and inferential statistics. The initial analysis involved computing means and standard deviations of teachers' acceptance and readiness scores, segmented by demographic variables, including age groups and educational qualifications. The data in this study were collected through a structured questionnaire consisting of 14 Likert-scale items. Responses were analyzed using descriptive and inferential statistics, including mean (M), standard deviation (SD), one-way ANOVA, and regression analysis. The hypothesis formulation is based on the TAM and the TPACK framework. These models suggested that teachers' perceived ease of use, perceived usefulness, and pedagogical knowledge influence their acceptance and readiness to integrate STEAM-based e-books into their teaching practices (Li et al., 2022; Sánchez-Prieto et al., 2017). Before conducting ANOVA and regression analyses, assumptions such as normality, homogeneity of variance, and independence of observations were tested. The Shapiro-Wilk test was used to assess normality, Levene's test checked homogeneity, and residual plots were examined for independence. All assumptions met the required thresholds, validating the use of these statistical techniques. This analysis revealed significant relationships between teachers' demographic characteristics and their acceptance

of STEAM-based e-books as vocabulary instruction resources. Graphs illustrated patterns of teacher readiness and acceptance across demographic groups.

2.6 Quality Control and Ethical Considerations

Quality control measures included double data entry verification for twenty percent of responses, regular research team meetings, and standardized data collection protocols. The study adhered to strict ethical guidelines under Institutional Review Board approval (Protocol #2024-001). Participants were assured of confidentiality and their right to withdraw at any time, with all data stored securely following institutional protocols.

3. Results

To obtain comprehensive results on teachers` readiness and competence, the author analysed the teachers' age and educational background. The retirement age for teachers was 60 years old. Meanwhile, the educational background varied from D3 (Diploma) to S1 (Bachelor) and S2 (Master.) Before filling out the questionnaire, teachers were asked to provide information related to age and educational background. Teachers who filled out this questionnaire were in the age range of 29 to 50 years and above. Based on the information, analysis was conducted per category. Table 2 presents the data for the teacher acceptance variable.

Table 2. Average Teacher Acceptance Scores by Age Group and Educational Background

Age Group	Diploma	Bachelor	Master
20-29	2.5	2.33	2.33
30-39	2.39	2.46	2.33
40-49	2.04	3.33	2.86
50+	1.47	2.33	2

In analyzing teachers' attitudes toward the adoption of the interactive e-book technology, we found that regarding its readiness the age 50+ group with a Diploma background was the least appreciative of the technology, with a mean of 1.47. This is due to a number of reasons, such as difficulties in using the new technology or lack of sufficient encouragement. Older teachers with a diploma background were less flexible and preferred conventional teaching styles, making them less likely to use interactive e-books in class. While determining how teachers with master's education in this age group accepted new technologies, it was found that this population accepted it at a mean of 2.00, which is still quite low compared to younger age groups. This could result from excessive expectations of this technology's effectiveness, where more educated teachers were said to be more 'demanding' and more concerned about the technology's effectiveness.

Conversely, the 40-49 age group, who had a Bachelor's background, had the highest acceptability (3.33), suggesting that this type of education, when combined with adequate teaching experience, provides the best proportion of willingness to accept new technologies and the ability to use them effectively. For instance, the readiness of the age groups of 20–29 and 30–39 and the attainment

levels across the four education levels were fairly uniform, with scores that averaged between 2.33 and 2.50. The implication here is that younger teachers were more flexible and more technology-savvy, regardless of their training. Together, the data suggested that technology training should align with the age and education cycle, particularly for older teachers with diploma-level education who require additional assistance. Subsequently, the maximum teacher readiness variable was investigated, and the following data was attained.

Table 3: Average Teacher Readiness Scores by Age Group and Educational Background

Age Group	Diploma	Bachelor	Master
20-29	2.82	3.17	3.2
30-39	3.42	3.22	2.25
40-49	2.31	3.19	3.15
50+	1.97	3	2.78

According to the Table 3, the highest readiness score of 3.42 was recorded among teachers with a diploma education background in the age of 30-39 in comparison to those with bachelor's and master's education. This is interesting since teachers with high educational backgrounds usually perform better in terms of technological readiness. Educators in this specific age group may have attained a specific stage in their professional career path and simultaneously received comprehensive training in both teaching and technology skills. They may only possess a diploma education, but practical exposure enables them to be more prepared for technology.

Meanwhile, among the time-related variables used here, age is very significant. Interestingly, teachers with a Bachelor's degree showed no differences across all age groups. Teachers with Bachelor's degrees displayed consistent readiness levels across age groups, with scores slightly above 3.0. This consistency suggests foundational technological competence irrespective of age. This indicates that teachers with Bachelor's degrees have fundamental technological skills and knowledge at the start of their careers. After ages 40-49 and 50+, their zeal diminishes, but even so, their scores with respect to readiness have not gone below 3.0, which meant that teachers with a Bachelor's degree have a reasonable level of technological readiness.

Educators aged 50 and over with a Diploma background had the lowest level of preparedness (1.97). This indicates a notable disparity in technological preparedness among older educators with lower educational qualifications. This inadequate preparation may stem from deficiencies in the technological training provided and reluctance to adopt technology in pedagogy. Older teachers with diploma-level education showed the lowest readiness scores, highlighting the need for targeted interventions. The readiness decline among master's degree holders in the 30-39 age group may reflect a mismatch between their advanced expectations and the perceived limitations of existing technology, a phenomenon often highlighted in studies on technology adoption in education, and feel that the present technology does not live to that hope pedagogically.

The 50+ age group had a readiness score of 2.78, a marginal improvement when compared to younger ages. Senior teachers with master's education may find it harder to use technology and ask for technology that is newer or more applicable to their schooling. Figure 1 compares the levels of teachers' acceptance and readiness towards the incorporation of STEAM-based e-books in the teaching of English vocabulary. In this case, the respondents were classified according to their age and level of education – Diploma, Bachelor, Master. A solid line represents the acceptance level, while a dashed line within each group represents the readiness level. This visualization assists in ascertaining the reasons behind differences in readiness and acceptance levels across age and education groups when practicing preschool education with technology.

Figure 1 illustrates the divergence between readiness and acceptance across educational levels, with diploma holders consistently scoring lower in both metrics compared to their peers.

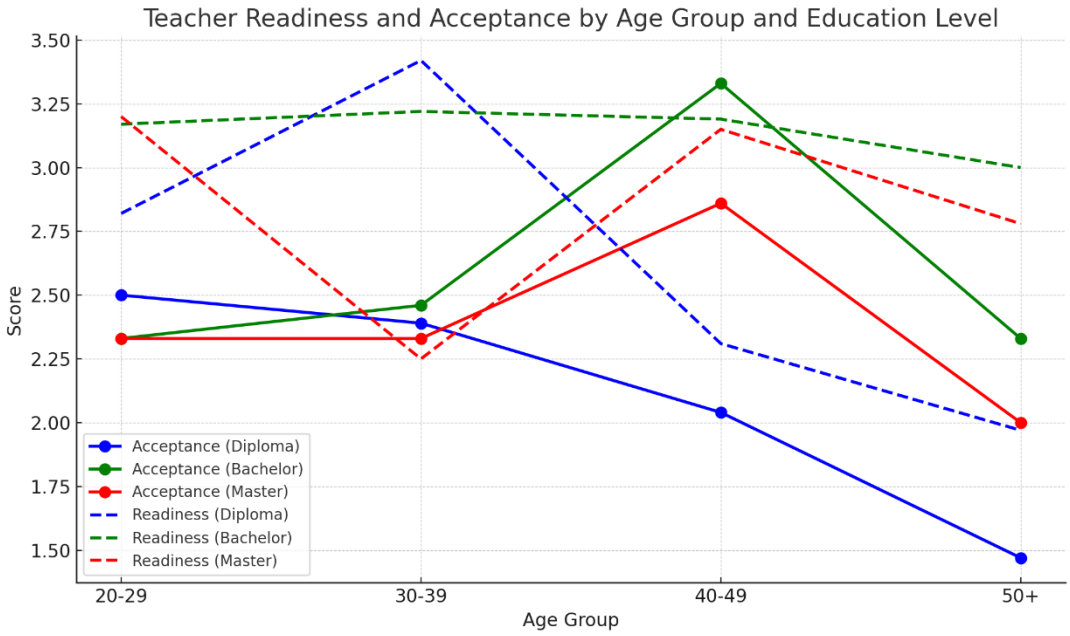

Figure 1: Chart of Teacher Readiness and Acceptance by Age Group and Education Level

The results revealed a significant variation in teachers' readiness and acceptance of STEAM-based e-book technology, influenced primarily by their education level. Acceptance levels generally lagged behind readiness across all groups, highlighting a disparity between capability and willingness. This means that whereas teachers were more than willing to embrace technological changes in teaching, teachers' acceptance of technology is lower. For instance, among the 30–39 age group with a diploma background, the score for readiness is 3.42, and acceptance is only 2.39. This suggests that even when teachers feel capable and ready, technology acceptance is lower than their readiness.

The inclusion of mean (M) and standard deviation (SD) provides a statistical summary of teachers' acceptance and readiness levels, facilitating a clearer

understanding of demographic variations. These measures help illustrate overall trends in technology adoption and highlight potential disparities among participants.

Teachers aged 40-49 with Bachelor's degrees demonstrated the highest acceptance (M = 3.33) and readiness (M = 3.19), indicating a positive relationship between education level and technology adoption. Nevertheless, for the 50+ age group with a diploma background, the mean values rendered in Table 3 for both readiness (1.97) and acceptance (1.47) of technology were critically low. It goes without saying that these factors limit the readiness and acceptability of technology for classroom usage by senior teachers. The low readiness scores among older teachers with diploma-level education (1.97) underscore the need for tailored professional development programs focusing on practical, hands-on training and tailored support.

We performed ANOVA statistical tests to analyze the impact of age and education level on teachers' acceptance and readiness of STEAM-based e-books to teach English vocabulary in preschools. This test aided in establishing whether or not the teachers' acceptance and readiness differed significantly among age groups as well as education categories. We also performed a linear regression to determine the relationship between teachers' readiness and their acceptance of this technology. This analysis assisted in identifying the primary determinants of increasing teachers' acceptance and readiness regarding the use of STEAM e-book technologies.

Table 4: ANOVA Statistical Tests for Acceptance

Source	Sum of Squares	Df	F-value	p-value
C(Age_Group)	0.962008	3	2.92	0.122
C(Education)	7.170112	2	21.77	0.00177
Residual	1.647862	6		

The results of the ANOVA test, as seen in Table 4, indicate that the level of education has a substantial impact on teachers' acceptance of STEAM-based e-books, evidenced by an F value = 21.77 and p-value = 0.00177. This suggests a statistical difference in the educational power of the teacher groups. To put it differently, teachers with higher education, such as bachelor's and master's degrees, are more receptive to STEAM-based e-book technology than teachers who have completed diploma education. This could be attributed to the fact that modern technology is more likely to be familiar to a person with advanced educational qualifications.

Comparatively, the ANOVA results showed that age group does not significantly influence technology acceptance, as evidenced by F = 2.92 and p-value = 0.122. This implies that a teacher's technology acceptance of STEAM-based e-book technology is similar among the different age groups. The difference is not significant enough to include the influence of age as a statistical factor. Therefore, we should disregard the age factor as a significant impediment to preschool teachers' adoption of this technology.

Table 5: ANOVA Statistical Tests for Teachers` Readiness

Source	Sum of Squares	Df	F-value	p-value
C(Age_Group)	0.136822	3	0.54	0.67
C(Education)	0.861884	2	1.13	0.383
Residual	2.281937	6		

The ANOVA results in Table 5 indicate that neither age nor education significantly impacts readiness. This suggests that external factors such as access to training and resources play a more critical role in shaping teachers' preparedness for technology adoption to employ STEAM-based e-books. For age, the F value = 0.54 with p-value = 0.670, and F for education = 1.13 with p-value = 0.383, showing that variation in readiness does not show in various age groups or education levels. In this case, young teachers and old teachers, diploma holders, or Bachelor or master degree holders were similarly ready to embrace this technology.

The findings suggest that demographic variables such as age or education do affect teachers' technological readiness to use STEAM-based e-book technology. Although there may be slight differences among the groups, the overall evidence does not support the assertion that these factors are the primary determinants of teachers' technological readiness. Enhancing readiness through more actual training and technology support would be more effective than relying solely on factors such as age or education.

Table 6: Regression Table for Teachers` Readiness and Acceptance

Coefficients	Standard Error	t-value	p-value
Intercept	1.2116	1.045	1.16
Readiness	0.5143	0.33	1.56

The linear regression analysis in Table 6 revealed no significant correlation between the teachers' level of readiness and their acceptance of using STEAM-based e-books. With a coefficient of readiness = 0.5143, t-value = 1.56, and p-value = 0.154, these findings also indicate that higher teachers' readiness to incorporate technology does not enhance their acceptance of it. Though a positive coefficient signified a positive association, this relationship was not strong enough to be statistically relevant. From the regression model, the R-squared is equal to 0.192, which indicates that — out of the total percentage of variance in teachers' acceptance — only 19.2 would be accounted for by teachers' readiness. This implies that factors other than the teachers' technical or pedagogical readiness outweigh the influence of these two dimensions. These findings suggest that readiness alone cannot drive the successful adoption of STEAM-based technologies. Comprehensive institutional support, including resource accessibility and ongoing training, is crucial to bridge the gap between readiness and acceptance.

4. Discussion

This study highlighted the critical role of teachers' readiness and acceptance in shaping the successful integration of STEAM-oriented e-books in early childhood education. Findings suggested that while technological readiness varies across educational backgrounds, structured professional development can enhance acceptance levels. We observed that teachers with Bachelor's and master's degrees accepted and embraced the technology more than those with a diploma level of education (Sánchez-Prieto et al., 2017). This accords with Ruiz-Palmero et al. (2023) and Li et al. (2022), stating that teachers who attained a higher education level were more likely to integrate technology when teaching other subjects since they had better exposure to technological advancements in learning institutions or workplaces. This trend can be attributed to their greater exposure to technological tools during formal education or professional development, which enhances their confidence and competence in leveraging such tools (Muftah, 2023). Our findings demonstrated that STEAM-based e-books effectively merge science, technology, engineering, arts and mathematics with English vocabulary instruction, providing preschool children with a holistic and engaging learning experience. For instance, activities that incorporated visual aids and interactive projects allowed the children to contextualize their newly acquired vocabulary in an effort to develop both language and cognition.

There is no apparent relationship between an individual teacher's age group and their level of technological readiness. The work of Gabarda-Méndez et al. (2023) supports this, concluding that teachers of diverse ages can benefit from inclusive training interventions in technology skills. With regard to English vocabulary acquisition, it is crucial to establish teachers' preparedness for embedding STEAM technologies into the learning process. As noted by Kamil and Anggraeni (2023), children will be able to learn English vocabulary and be introduced to new STEAM concepts through the creative integration of visuals and active STEAM projects with the use of electronic books.

While teacher readiness explained only 19.2% of the variance in acceptance, this suggested that other factors, such as the perceived usefulness of STEAM-based e-books and institutional support, play a more significant role. This finding aligns with Rahayu et al. (2022) who emphasized the importance of contextual factors in technology adoption for early childhood education. The difference may be explained by other variables, including teachers' understanding of how useful the STEAM language-based e-books are in helping them learn English language skills, as well as institutional backing (Nzai & Boleli, 2013; Setyowati, 2022). Govender and Dhurup (2014) explained that a factor in technology acceptance by teachers is how these technologies are likely to benefit students' learning. With respect to teaching English to children, STEAM e-books can enhance vocabulary learning by integrating language concepts into engaging, hands-on activities.

The core outcomes of this study indicated that the use of e-books with STEAM has great potential as a resource for teaching English vocabulary to preschool-aged children. Although a teacher's educational level influences technology acceptance, the results suggest that STEAM-based e-books can be effectively integrated into various educational settings. However, pre-training is essential to ensure teachers

are adequately prepared for this integration (Solórzano & de-Oliveira, 2012; Soroko, 2020).

These findings contribute to the development of targeted training programs and resource allocation strategies that enhance kindergarten teachers' readiness and acceptance of STEAM-oriented e-books for English vocabulary instruction. Including meaningful language learning with the help of different interactive and interdisciplinary activities creates scope for bringing creativity and critical thinking (Awang et al., 2020; Zain, 2023). The incorporation of STEAM e-book materials will not only facilitate English vocabulary in the learning process but also enable children to learn in an interactive and multisubject manner. By incorporating concepts of science, technology, engineering, arts and mathematics, children can learn English vocabulary in a more meaningful and relevant context (Colegrove, 2017; Putri et al., 2024). This study offers a novel perspective by showing how integration of STEAM e-books can simultaneously advance language acquisition and interdisciplinary learning in preschool education. Unlike traditional methods, this approach contextualizes vocabulary within practical and creative activities, setting a foundation for innovative teaching strategies that address the needs of twenty-first-century learners (Alwi et al., 2024; Klop et al., 2018).

The findings of this study have important implications for teacher training programs, curriculum development, and policy-making. Schools should incorporate structured professional development programs that focus on enhancing teachers' digital literacy, particularly in STEAM-based education. In addition, educational policymakers should prioritize the integration of interactive e-books to bridge the gap between traditional and technology-driven pedagogy, ensuring accessibility across different school settings.

Future studies could investigate the long-term effects of STEAM integration on language and cognitive development (Ismaniar et al., 2023; Zainil et al., 2024). These results underscored the need for teacher education programs to incorporate STEAM activities within English language training modules. Educators learn how to use STEAM-based e-books effectively for the acceptance and readiness for technology gaps in order to realize innovative pedagogical modes of delivery congruent with 21st-century learning objectives (Hazizah et al., 2024; Hughes et al., 2021). With the use of developed English-teaching materials, schools and educational establishments will be able to implement a more integrated approach, which not only teaches the English lexicon but also develops critical and creative thinking in children with the help of STEAM approaches (Setiawati & Handrianto, 2023; Yakymenko et al., 2020).

5. Conclusion

This study found that preschool English vocabulary teachers with higher education levels were more receptive to using STEAM-based e-books compared to their colleagues with less education, who did not consider such tools appropriate regardless of age. Those teachers with higher qualifications were more accepting of the incorporation of technology into their teaching practice compared to those with diploma education. However, technological readiness is

consistent among teacher groups, indicating room for improvement through training and support. We also confirmed that a teacher's technological need does not statistically influence their acceptance of the technology, as other factors, such as perceived usefulness and the level of institutional support, appear to be more significant. These findings support the development of STEAM-based e-books for teaching English vocabulary to children. There are opportunities for STEAM e-books to incorporate vocabulary learning with other concepts in a more interactive way. Therefore, the results of this research significantly contribute to curriculum development, in-service teacher training, and the continued use of this technology in preschool English teaching. Although this study used quantitative data, future research should incorporate qualitative methods, such as interviews, to gain deeper insights into teachers' perspectives on STEAM-based e-books.

6. Acknowledgement

The authors would like to thank the Institute for Research and Community Service, Universitas Negeri Padang, for funding this work with contract number: 1392/UN35.15/LT/2024.

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