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Utilization of interactive E-book in bridging the least learned competencies in statistics and probability

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Abstract
This experimental study with purposive non-probability sampling focused on investigating the results before and after using interactive e-books by the Grade 12 students at Southville 1 Integrated School during the academic year 2022-2023. This study was conducted among 108 students in Grade 12 who answered the 20-item pre-test and 20-item post-test with a 5-point Likert scale survey. This study used mean, standard deviation, and mean percentage scores to determine the effectiveness of interactive e-books in bridging the least learned competency and a paired sample t-test test to analyze the significant difference between the respondents' performance before and after utilizing the interactive e-book. The study showed a significant mean difference in pre-test and post-test scores, indicating a significant decrease in scores before the intervention. However, interactive e-books resulted in a considerable performance improvement, as evidenced by the t-value and low p-value, which revealed a significant difference between the two scores. The effect size of 1.93 was likewise adequate, showing the magnitude of the observed effect. The findings indicate that interactive e-books can increase students' academic performance and learning outcomes as digital learning materials. The study finds that using interactive e-books in the classroom can increase student engagement, comprehension, and overall academic achievement.

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Introduction

Monitoring student progress is an essential responsibility of teachers, and consistent follow-ups and practices are necessary. In cases where students require assistance or remediation, teachers may visit them at home (Llego, 2020).

In some areas, teachers or local government officers distribute printed modules to students, parents, or guardians, particularly in rural areas. Parents, guardians, and representatives typically visit schools in urban areas to obtain printed modules and bring them back to students' homes. While ensuring access to education for all is essential, the rising costs of textbooks and printed materials can hinder students' learning (Pascua, 2022). Families often face difficulty deciding between spending money on textbooks, meeting their basic needs, and paying bills. This urgent issue poses a significant risk of poor academic performance and low completion rates for primary education.

In response to the COVID-19 public health emergency, DepEd Order No. 012 was issued on June 19, 2020, aiming to provide continuity of learning through K-12 curriculum adjustments, material alignment, diverse delivery methods, teacher and school leader training, and the right approach to learning for parents and guardians. Technology, including electronic books (e-books), has been recognized as crucial in developing educational systems. E-books, a technology-enabled publication format, offer more accessible access to knowledge than traditional printed books. They can serve as study aids during in-class lectures or be used

by students during their time, such as in a flipped learning environment.

Interactive e-books are an advanced version of digital books, providing students with an enhanced and engaging learning experience. They include interactive multimedia elements, animations, and simulations, making complex subjects easier to understand and promoting student engagement. Interactive e-books can be accessed on various devices, such as tablets, smartphones, e-readers, and computers. Examples include interactive children's books with games and puzzles and educational textbooks with multimedia resources.

Using instructional materials, including interactive e-books, helps students become familiar with higher levels of learning. It also aids teachers in delivering lessons and goals effectively. Instructional materials bridge the gap between teaching and learning processes, especially in the new normal of education. They expose students to different methods and solutions applicable to higher math skills and real-life situations (Candelaria, nd).

Interactive e-books offer engaging content, making learning more enjoyable for students than text-based e-books. One significant advantage is that they allow students to learn at their own pace, which is crucial for comprehending complex subjects like statistics and probability. Additionally, interactive e-books enable teachers to assess students' progress and provide customized feedback. Teachers can incorporate quizzes, games, and other interactive features to enhance students' understanding and comprehension.

A study by Sagge & Espiritu (2023) found that despite students taking statistics and probability classes, they still have not fully mastered competencies. Individual variations and the pandemic-induced learning mode may contribute to this. Teachers must consider the unique qualities of each student and plan appropriate teaching methods to promote their growth and development at their own pace. Providing materials that aid learners in developing the required competencies, such as self-guided modules, is essential. Students learn best when they can work at their own pace, assuming they can meet the deadlines set by instructors or the institution. Self-directed modules with progress indicators, learner information, and progress records help students track their progress.

Platforms like Kotobee Author and Kotobee Reader revolutionize the delivery of educational content. Kotobee Author empowers teachers and authors to create interactive e-books effortlessly, enriched with multimedia elements, animations, and simulations. This results in a more immersive and dynamic learning experience. Students can access these interactive e-books through the Kotobee Reader, a versatile application available on various devices. The Kotobee Reader allows students to learn at their own pace, track their progress, and stay engaged with the content.

Kotobee Author and Kotobee Reader address the challenges posed by traditional textbooks and printed materials. These digital tools offer a more affordable and interactive alternative, empowering teachers to provide engaging and accessible learning materials. Using Kotobee Author, teachers can create interactive e-books tailored to their student's needs, promoting comprehension and active learning. Meanwhile, the Kotobee Reader facilitates seamless access to these e-books, enabling students to learn anytime and anywhere, enhancing their educational experience.

Using digital copies of Self-Learning Modules (interactive e-books) with the Kotobee Reader application can promote satisfactory academic achievement among students. Mathematics teachers can facilitate change in their classes by using interactive e-books to improve conceptual comprehension, process, cognitive skills, and technical abilities. This could be done by accessing an interactive e-book via the Kotobee Reader application for educators, which could be one of the instructional resources implemented to encourage favorable alterations in students' learning and encounter (Siano & Potane, 2022) [62].

Mobile learning, facilitated by interactive e-books, can improve teacher-student interaction by providing educational materials accessible anywhere and anytime. This modern innovation has numerous benefits for students and teachers, enhancing communication throughout the educational process. E-books promote 21st-century skills such as critical thinking, creativity, cooperation, and communication.

The research aims to evaluate how well interactive e-books can address the least mastered statistical and probability competencies. The study seeks to investigate the potential of e-books as a learning material and contribute to developing instructional strategies that encourage student engagement and active learning. The results of this study can inform teachers and policymakers about the benefits and drawbacks of using e-books for teaching statistics and probability.

The selected grade 12 students from Southville 1 Integrated National High School are the respondents of the study "Utilization of Interactive E-book in Bridging the Least Learned Competencies in Statistics and Probability" since they are already finished taking up the Statistics and Probability.

Methodology

Research Design

The research design that was utilized for this study was experimental research. This type of design was essential for conducting quantitative research. A well-designed research proposal helped researchers collect reliable information, draw better conclusions, and solve the main research issue successfully. A precise study objective, testable hypotheses, and well-defined variables were all components of an effective experimental research design (Sunil, 2023).

The researchers conducted a pre-test to determine the respondents' current level of statistics and probability competency among the selected Grade 12 learners at Southville 1 Senior High School. Upon that, the researchers introduced the interactive e-book intervention using Kotobee Reader and gave the respondents the necessary instructions. The respondents were then given access to the interactive e-book and invited to utilize it as a tool to develop their statistics and probability skills.

Lastly, the researchers conducted a post-test to determine the individuals' level of competency after the intervention had finished. The researchers compared the participants' pre-test and post-test results to determine whether there was a significant improvement in their competencies after utilizing the interactive e-book.

Source of Data

The researchers in this study collected information from both primary and secondary sources. The primary sources of data included the respondents, an interactive e-book, a pre-test and post-test tailored from the interactive e-book, and an adapted

survey from the study of Caro (2020) [16]. These sources provided direct and firsthand information that is specific to the study.

On the other hand, secondary sources of data were gathered from a variety of published materials. These may include encyclopedias, books, newspapers, journal articles (such as those found on Google Scholar), educational department websites (e.g., DepEd), web information, prior studies, relevant studies, and existing literature. Secondary sources provide existing knowledge and information that can support and contextualize the study's findings.

By utilizing both primary and secondary sources of data, the researchers aim to gather a comprehensive range of information to inform their study. The primary sources offered specific insights from the respondents and the interactive e-book, while the secondary sources provided broader context and existing knowledge from various published materials.

Respondents/Participants of the Study

The researchers conducted a study at Southville 1 Senior High School; the study participants were the Grade 12 least-performing students in statistics and probability from the previous school year, with a total of 108 senior high school students. The researchers chose a purposive sampling technique, a non-probability sampling method where units of participants are selected because they possess specific characteristics that the researchers require for their sample.

Sampling Design

The sample in this study consists of 108 Grade 12 senior high school students from the strands of GAS, EIM, HUMSS, and HE. The researchers employed a purposive sampling technique to select the participants. Purposive sampling is a non-random sampling method where the researchers intentionally choose individuals who meet specific criteria or possess certain characteristics relevant to the study.

In this case, the researchers chose respondents who struggled in mathematics and had lower grades. They relied on their judgment to identify and select individuals from the population who participated in the study on using interactive e-books to bridge the least learned competency in Statistics and Probability. By focusing on students with lower grades in mathematics, the researchers aimed to examine the effectiveness of interactive e-books in helping bridge the gap in the least learned competency in Statistics and Probability.

Instrumentation and Validation

The researchers used a test questionnaire in Statistics and Probability that had been adapted from an interactive e-book. The instrument was used to answer the following statement of the problem.

The test had two parts: the pre-test and post-test questionnaires, which consisted of 20 items. It aimed to provide the requisite information to measure the effectiveness of interactive e-books for Grade 12 learners. The instrument of the study underwent face and content validity. The researcher validated the pre-test and post-test questionnaires with the language editor, practice teachers, master teachers, and research adviser.

Data Gathering Procedure

The researchers took the following steps in gathering data for the study:

The researchers first asked permission from the division office to access and identify the least learned competencies in statistics and probability at Southville 1 Senior High School. Once the researchers received approval, they provided an interactive e-book that addressed the identified competencies. This e-book served as an intervention tool to improve students' understanding of statistics and probability. Next, the researchers prepared statistics and probability tests; these tests were meticulously checked and validated by the research adviser, math practitioners, master teachers, and language editors to ensure their reliability and accuracy. Following this step, the researchers wrote another letter to the division office, submitting various documents, including a letter for the respondents, a letter for approval, an adapted e-book, a sample test questionnaire, and a copy of the problem statement.

Once the approval from the Division Superintendent and the School Principal was obtained, the researchers distributed the prepared tests to the identified respondents, who were grade 12 students at Southville 1 Senior High School. Simultaneously, the e-book was adapted using Kotobee Reader to cater specifically to the needs of the participants. Throughout this process, the researchers ensured that the data provided by the respondents was treated confidentially and handled with utmost privacy and anonymity.

After collecting the data, the statistician validated its accuracy and reliability. Subsequently, the researchers analyzed the data, interpreted the findings, and drew conclusions about the e-book intervention's effectiveness in enhancing the participants' statistics and probability competencies. Based on the study's results, the researchers could provide recommendations and action plans for further improvement or modifications to the intervention, aiming to enhance its impact in educational settings.

Statistical Treatment

The researcher gathered quantitative details regarding the utilization of an interactive e-book in bridging the least learned competencies in statistics and probability. The following statistical treatments was used to determine the solution to particular problems and test the hypothesis of the study:

1. The mean and standard deviation was used to determine the level of acceptability of interactive e-books in terms of context, objective, suitability, and adequacy.
2. The mean, standard deviation, and MPS (mean percentage score) was used to determine the respondents' performance before and after utilizing the interactive e-book.
3. A paired sample t-test was used to determine the significant difference in the respondents' performance before and after the utilization of interactive e-books.

Ethical Consideration

The study sought approval for its proposed data-gathering process and data-gathering instruments, taking into account various ethical considerations to ensure their acceptance throughout the data collection and analysis phases. To protect the rights and well-being of the research participants, particularly the students and teachers involved, great emphasis was placed on upholding the principles of informed consent and safeguarding data privacy. Before involving any participants in the study, the researchers diligently obtained informed consent from each individual. This comprehensive

process ensured that all participants, including students and teachers, received precise information about the research's purpose, their involvement, potential risks and benefits, and their right to voluntary participation or withdrawal without facing any negative consequences. For the minor participants, consent forms were also provided to their parents or legal guardians following ethical guidelines.

In addition to ethical considerations surrounding consent, the researchers strictly adhered to the Data Privacy Act of 2012 (Republic Act No. 10173) to protect the participants' data. Strict measures were implemented to collect, process, and store the data securely, with the utmost respect for the privacy and confidentiality of the participants. Personal identifiers were minimized, and whenever possible, data was anonymized to safeguard the identities of those involved.

The researchers maintained transparent data use throughout the study to ensure ethical practices. Participants were fully informed about the purpose of data collection and how their information would be utilized and shared. Any intentions to use the data beyond the research scope were explicitly communicated, and participants' consent was actively sought for such purposes.

By adhering to these rigorous ethical considerations, including providing consent forms to the parents of students, the researchers ensured that the research on utilizing interactive e-books to bridge the least learned competencies in Statistics and Probability was conducted with the utmost integrity, safeguarding the rights, welfare, and privacy of all those involved.

Result and Discussion

Presented in this section the presentation of data, analysis, and interpretation to investigate the correlation between vocabulary skills and their reading comprehension abilities.

Specifically, this aims to answer the following

1. What is the level of acceptability of interactive e-book in terms of:
   1.1. Content;
   1.2. Objectives;
   1.3. Suitability; and
   1.4. Adequacy?

Table 1: The Level of Acceptability of Interactive E-book in Terms of Objectives

Statement	Mean	Std Dev	Verbal Interpretation
1.1 Cover the specific component of the individual topic.	4.67	0.58	Highly Acceptable
1.2 Allow the assessment and reflect the individual performance of the student.	4.33	1.15	Highly Acceptable
1.3 Permit the completion of the topic according to its coverage.	4.67	0.58	Highly Acceptable
1.4 Provide the student the way to connect the lesson to its real-life.	4.67	0.58	Highly Acceptable
1.5 Realize the objective in specified period of time.	4.00	1.00	Moderately Acceptable
Overall Weighted Mean	4.47	0.28	Highly Acceptable

Legend: Poorly Acceptable (1.79 – 1.00); Fairly Acceptable (2.60 – 1.80); Acceptable (3.40 – 2.61); Moderately Acceptable (4.20 – 3.41); Highly *Acceptable (5.00 – 4.21)*

The data presented in Table 1 illustrates the degree to which an interactive e-book is acceptable in terms of its objectives—with a mean score of 4.67 and a standard deviation of 0.58, statements 1.1, 1.3, and 1.4 had the highest level of acceptability. Statement 1.5 had a somewhat acceptable mean score of 4.00 with a 1.00 standard deviation. According to the data's overall weighted mean of 4.47 and a slight standard deviation of 0.28, the interactive e-book successfully reached its goals. The majority of the statements had high mean scores and low standard deviations, which suggests that respondents generally agreed with each other about how well the e-book covered particular topics, facilitated assessment and reflection, allowed topic completion, and connected lessons to real-life scenarios.

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The adoption of eBooks in schools has improved the quality of education. The goal of eBooks is to simplify and improve the learning experience. Digital Books make learning more dynamic and interesting for pupils and may be presented to them at an early age. A successful learning system must include students actively in the learning process, and eBooks have ushered in an educational reform that allows pupils to learn better and quicker. This has improved the overall quality of education provided (Harman, 2023) [28].

The high level of acceptability of the interactive e-book, as indicated by the mean scores and low standard deviations, implies several important implications. The e-book's effectiveness in covering specific topics, facilitating assessment and reflection, and connecting lessons to real-life situations suggests its value in enhancing the delivery of curriculum materials and promoting comprehensive and targeted learning experiences. Additionally, the e-book's ability to support formative and summative evaluations, promote self-assessment, and bridge the gap between theoretical knowledge and practical application highlights its potential to improve educational outcomes and create more engaging and effective learning environments. With the advancement of technology and interactive features, adopting interactive e-books can revolutionize education, providing students with dynamic and personalized learning experiences that foster more profound understanding and higher achievement.

Table 2: The Level of Acceptability of Interactive E-books in Terms Content

Statement	Mean	Std Dev	Verbal Interpretation
3.1 Contain lesson that challenge the understanding of the learners.	4.67	0.58	Highly Acceptable
3.2 Include summarized topics that equip the learners to a higher level of understanding.	4.00	1.00	Moderately Acceptable
3.3 Include pictures that supplement the conceptual understanding of the topic.	5.00	0.00	Highly Acceptable

3.4 Give directions that are easy to follow.	5.00	0.00	Highly Acceptable
3.5 Stimulate the formative and critical thinking of the students	4.67	0.58	Highly Acceptable
Overall Weighted Mean	4.67	0.43	**Highly Acceptable**
Legend: Poorly Acceptable (1.79 – 1.00); Fairly Acceptable (2.60 – 1.80); Acceptable (3.40 – 2.61); Moderately Acceptable (4.20 – 3.41); Highly *Acceptable (5.00 – 4.21)*			

The data presented in Table 2 evaluates how acceptable interactive e-books are in terms of their content. The highest mean scores of 5.00 were obtained by statements 3.3 and 3.4, with a perfect standard deviation of 0.00, indicating a very satisfactory level of content. These claims imply that e-books have illustrations that aid conceptual understanding and straightforward instructions. Statement 3.2 received the lowest mean score of 4.00 with a standard deviation of 1.00, indicating a moderately acceptable level of content. The lack of variation in ratings suggests that all respondents agreed on the effectiveness of these aspects, highlighting the ability of the e-books to enhance understanding through visual aids and provide clear and concise instructions. Based on the findings, the e-books contain themes that have been explained to help students understand concepts at a deeper level. The greater diversity in responses, indicated by the higher standard deviation, shows that the respondents' viewpoints are more varied.

Overall, the data demonstrate a highly acceptable level of content for the interactive e-books, as indicated by the weighted mean of 4.67 with a relatively low standard deviation of 0.43. The high mean scores and common standard deviations for the majority of the statements indicate general agreement among the respondents regarding the e-books' content, including challenging lessons, summarized topics, visual supplements, easy-to-follow directions, and stimulation of critical thinking skills.

E-books have the same components as textbooks but feature problem-solving and multimedia content activities such as simulations, animations, and movies that enhance students' creative thinking skills throughout every subject, including fluency, originality, flexibility, and elaboration. The findings of this study suggest that an interactive e-book can assist students in developing their creative thinking abilities (R Adawiyah et al., 2019).

As the data indicates, the highest acceptable level of content in interactive e-books carries significant implications for education. Including pictures that supplement conceptual understanding and the provision of easy-to-follow directions contribute to enhanced comprehension and engagement among learners. This implies that interactive e-books have the potential to facilitate a more interactive and visually stimulating learning experience, catering to different learning styles and promoting a deeper understanding of the subject matter. Furthermore, including summarized topics that equip learners with a higher level of performance suggests that e-books can effectively support knowledge synthesis and critical thinking skills. By presenting information concisely and organized, e-books can help students develop a broader and more comprehensive understanding of complex topics. Overall, integrating interactive e-books in education can foster creativity, critical thinking, and deeper engagement with the content, empowering learners to become active participants in their own learning journey.

Table 3: The Level of Acceptability of Interactive E-book in Terms of Suitability

Statement	Mean	Std Dev	Verbal Interpretation
2.1 The number of lessons is substantial enough to be completed in a given allotted time.	4.00	1.00	Moderately Acceptable
2.2 The IE used a simple and suitable language easy to understand by the learner.	5.00	0.00	Highly Acceptable
2.3 The IE provides enough number of exercises expected to be completed in one sitting.	4.67	0.58	Highly Acceptable
2.4 Lessons are chosen and arranged according to sequential progression of pre-determined topic.	4.67	0.58	Highly Acceptable
2.5 Uses language/terms that are within the level of knowledge and understanding of the learners.	4.33	0.58	Moderately Acceptable
Overall Weighted Mean	4.53	0.36	**Highly Acceptable**
Legend: Poorly Acceptable (1.79 – 1.00); Fairly Acceptable (2.60 – 1.80); Acceptable (3.40 – 2.61); Moderately Acceptable (4.20 – 3.41); Highly *Acceptable (5.00 – 4.21)*			

The data in Table 3 evaluates an interactive e-book's level of acceptance in terms of its suitability. The statement with the highest mean score—Statement 2.2—had a perfect standard deviation of 0.00 and a mean score of 5.00, suggesting high appropriateness. This claim implies that the e-book effectively uses straightforward, appropriate language that is basic enough for learners to grasp. The lack of variation in scores suggests that all reviewers agreed that the e-book's language was appropriate, reflecting how well it gave understandable and straightforward material. Statement 2.1, on the other hand, had the lowest mean score of 4.00 with a standard deviation of 1.00, suggesting a level of appropriateness that is only marginally acceptable. The statement implies that the e-book's lessons are substantial enough to be finished in the allocated amount of time. The greater diversity in replies, as shown by the more significant standard deviation, suggests that respondents' opinions on this topic were more varied.

Overall, the data reveal a highly acceptable level of suitability for the interactive e-book, as indicated by the overall weighted mean of 4.53 with a relatively low standard deviation of 0.36. The high mean scores and common standard deviations for the majority of the statements indicate a general agreement among the respondents regarding the e-book's suitability in terms of using suitable language, providing an adequate number of exercises, arranging lessons sequentially, and utilizing appropriate language and terms.

The study by Alshehri (2021) discovered that students who used electronic sources improved their educational skills more than those who used non-digital materials. The success of the e-books was supported by student motivation since e-books provided higher involvement in lessons and links to other educational programs to solve inquiries efficiently. E-books that are specifically developed to boost students' teaching and learning and are linked to different platforms and connections aid in building students' interest.

The high level of acceptability in terms of suitability of the interactive e-book, as indicated by the data, holds significant

implications for education. The e-book's effective use of simple and suitable language enables learners of different levels to comprehend and engage with the content, supporting inclusive education. Providing adequate exercises and a sequential arrangement of lessons promotes a structured learning experience, enhancing the efficiency and effectiveness of knowledge acquisition. However, the moderately acceptable rating for the completion of lessons within the allotted time suggests the need for further consideration of pacing and time management. Integrating interactive e-books into education can improve learning outcomes, foster student engagement, and create personalized and inclusive learning environments.

Table 4: The Level of Acceptability of Interactive E-books in Terms of Adequacy

Statement	Mean	Std Dev	Verbal Interpretation
4.1 The presentation of lessons in the IE motivates the students to go to the next activity.	4.67	0.58	Highly Acceptable
4.2 Contain illustrations appropriate in every lesson.	4.67	0.58	Highly Acceptable
4.3 The number of examples presented is adequate to serve as an aid of learning.	4.67	0.58	Highly Acceptable
4.4 The information shared by each topic reflect the salient idea required for complete understanding of the lesson.	4.33	0.58	Moderately Acceptable
4.5 Exercises in each topic showed the required variety to urge the learner to continuously work for it.	4.33	0.58	Moderately Acceptable
Overall Weighted Mean	4.53	0.00	**Highly Acceptable**
Legend: Poorly Acceptable (1.79 – 1.00); Fairly Acceptable (2.60 – 1.80); Acceptable (3.40 – 2.61); Moderately Acceptable (4.20 – 3.41); Highly *Acceptable (5.00 – 4.21)*			

The data presented in Table 4 assesses the level of acceptability of interactive e-books in terms of their adequacy. The highest mean scores were obtained by Statements 4.1, 4.2, and 4.3, all of which had a standard deviation of 0.58 and a sufficiency level that was deemed to be quite satisfactory. These claims imply that the manner in which lessons are presented in the electronic books encourages students to go on to the next task, has suitable images in each lesson, and offers a sufficient number of examples to facilitate learning. Although the moderate standard deviation suggests some variation in replies, overall, respondents agree that these elements of the e-books are beneficial. The mean scores for statements 4.4 and 4.5 were significantly lower, at 4.33 and 0.58, respectively, indicating a moderately adequate degree of adequacy. These claims imply that each topic's content represents the key concept needed for full comprehension of the lesson and that each topic's activities exhibit the necessary variation to encourage ongoing participation. In contrast to the previous claims, the standard deviation implies some variance in replies, showing that respondents' opinions on these elements ranged more widely.

Overall, the data reveals a highly acceptable level of adequacy for the interactive e-books, as indicated by the overall weighted mean of 4.53 with a standard deviation of 0.00. The high mean scores for the majority of the statements, along with the moderate standard deviations, suggest that the e-books generally meet the criteria of providing motivating lesson presentations, appropriate illustrations, adequate examples, and exercises with variety to facilitate continuous learning and engagement. This indicates that the e-books have the potential to effectively support and enhance the learning experience of students.

In the study of Siano and Potane (2021) [62] believe that e-books are an important learning tool that may assist students in learning new skills online. The study looked at how much students learned from electronic text versus printed information. Those who used an electronic textbook (e-book) outperformed those who used a paper textbook on comprehension exams. An interactive e-book could be utilized in mathematics instruction to improve conceptual comprehension, process, cognitive, and technical abilities.

The results of findings indicate that motivating lesson presentations, appropriate illustrations, and an adequate number of examples are positively perceived by students. However, there is room for improvement in terms of reflecting salient ideas in the shared information and providing a variety of exercises. Overall, the study highlights the potential of interactive e-books to enhance student engagement and learning outcomes, emphasizing the importance of incorporating visually appealing and interactive elements in educational materials. Further integration and refinement of interactive e-books can contribute to more effective and engaging learning experiences for students.

2. What is the performance of the respondents before and after the utilization of interactive e-books?

Table 5: Mean Percentage Score Before and After Utilization of Interactive E-book

Indicator	Mean	SD	MPS	Remarks
Pre-test	6.5	1.88	32.5	Beginning
Post-test	13.20	2.11	66.02	Beginning
Legend: 74 and below=Beginning; 75-79=Developing; 80-84=Approaching Proficiency; 85-89=Proficiency; 90 and above=Advance				

Based on the data provided in Table 5 presents additional indications as well as the mean percentage scores (MPS) before and after using an interactive e-book.

Participants got an average score of 6.5 on the pre-test, with a standard deviation of 1.88 and an MPS of 32.50. The participants' average score climbed significantly to 13.20 with a standard deviation of 2.11 and MPS of 66.02 after using the interactive e-book and taking the post-test.

This improvement indicated that the interactive e-book had a beneficial effect on their performance as the MPS of the post-test was 66.02 with the remarks of starting. Although there was some variation in the individuals' results, the standard deviation of 2.11 reflected this. Despite the progress, the MPS for the pre-test was 32.5 with a standard deviation of

1.88, still falling within the beginner category, according to the observations. This suggested that while there had been improvement, overall participant performance had remained at a beginner's level.

Educators constantly strive to improve student learning experiences, leading to an ongoing evolution of teaching and learning pedagogies. Teaching pedagogies are educators' various methods, strategies, and approaches to facilitate student learning. Effective pedagogies should be student-centered, meaning that they prioritize learners' needs, interests, and motivations (Lai & Kritsonis, 2018) [38]. Teaching pedagogies denote the techniques and methodologies that educators utilize to foster the learning of the students. Successful pedagogies must rely on solid theoretical frameworks and integrate the principles of active learning and learner-centeredness (Wang & Hannafin, 2019) [69].

Table 6: Test of Significant Differences Between Before and After Utilization of Interactive E-book

Indicator	Mean Difference	t	P-Value	Effect Size	Verbal Interpretation
Pre-test	– 6.704	– 36.190	0.000*	1.93	Large
Post-test					

*Significant at 0.05; N=108 Effect size: small (0.2); medium (0.5); large (0.8)

The data presented in table 6 provides insight into the findings of a test that looked at the variations between pre-test and post-test scores following the use of an interactive e-book. The results revealed several crucial insights. First, a sizable mean difference between the pre-test and post-test was -6.704, indicating a significant drop in scores. The utilization of the interactive e-book also significantly improved performance, as shown by the t-value of -36.190, which also showed a significant difference between the two sets of scores. This is further supported by the fact that the observed differences are extremely unlikely to have arisen by chance alone, as indicated by the low p-value of 0.000*. A strong influence is shown by the effect size, estimated as 1.93, and measures the magnitude of the observed effect.

According to Siano and Potane (2021) [62] study, students improved their understanding after obtaining digital copies of mathematical Learning Materials (E-books). Students gained intermediate proficiency in mathematical knowledge and skills, particularly in sequence themes, using an offline mode widget, video courses, and interactive evaluations via questionnaires. As a result of the new features that promote more interactivity and reachability, e-books can improve how learners assimilate their knowledge. According to UNICEF (2021), Digital learning strategies have been demonstrated. However, it should be emphasized that some studies contend that students who read books in print score much better in reading comprehension than those who read them digitally. This is because students' attitudes, enthusiasm, and inclinations toward learning are found to rise.

The findings support the positive impact of interactive e-books on student learning outcomes. The significant differences observed between pre-test and post-test scores and the large effect size indicate that the utilization of interactive e-books led to a substantial improvement in test performance. These findings emphasize the value of interactive e-books as practical educational tools, offering interactivity, accessibility, and improved assimilation of knowledge. Incorporating interactive e-books into educational practices can enhance student engagement, deeper understanding, and overall academic achievement.

Conclusions

Interactive e-books are highly acceptable for their objectives, content, suitability, and adequacy. They efficiently address individual topics, promote evaluation and reflection, improve comprehension and engagement, and provide links to real-life situations. The use of interactive e-books in the classroom can improve learning outcomes, increase student engagement, and create individualized learning environments. The study found that using interactive e-books significantly improved participants' performance, but post-test scores remained at the beginning level. More treatments or longer-term e-book use may be required for more significant performance improvements. The study found a significant difference between pre-test and post-test scores, indicating that interactive e-books significantly impact test scores. Incorporating interactive e-books into teaching techniques can improve student engagement, comprehension, and overall academic accomplishment.

References

1. Abdullah MH, Rahman MM, Begum S. Kotobee: An ebook creator software for self-publishing. Int J Eng Technol (UAE). 2018; 7(3.21):231-235.
2. Alves L, Viana J, Tavares C. The impact of gamification on learning mathematics: A systematic review. J Educ Comput Res. 2019; 57(7):1688-1711.
3. Al-Fahad FN, Salloum SA. The effectiveness of mobile learning in educational environments. Int J Interact Mob Technol. 2018; 12(6):76-89.
4. Akcayir M, Akcayir G. Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educ Res Rev. 2018; 20:1-11.
5. Asrowi, Hadaya A, Hanif M. The Impact of Using the Interactive E-Book on Students' Learning Outcomes. ResearchGate. 2021; 12(1308-1470). https://doi.org/10.29333/iji.2019.12245a
6. Baring JJA, Berame JS. Supporting Conceptual Comprehension of Newton's Laws of Motion of Grade 8 Students through Kotobee Interactive E-Module. Indones J Learn Adv Educ. 2022. Available at: https://journals.ums.ac.id/index.php/ijolae/article/view/18790 (Accessed: February 24, 2023).
7. Barndorff-Nielsen OE, Cox DR, Klüppelberg C, Sato K. Probability theory: independence, interchangeability, martingales. Springer; 2018.
8. Bhattacharya A, Dunson DB. Nonparametric Bayesian modeling of networks. J Am Stat Assoc. 2018; 113(523):1634-1646.
9. Belton P, Wall M. Did technology kill the book or give it new life? BBC News. 2015. Available at: https://www.bbc.com/news/business-33717596.
10. Biancarosa G, Griffiths GG. Technology tools to support

reading in the digital age. Read Teach. 2018; 72(4):437-441.
11. Blickle G, Meurs JA, Wihler A. Which competencies do young professionals need? A Delphi study on the expectations of employers, universities and young professionals themselves. Pers Rev. 2018; 47(3):696-713.
12. Boaler J. Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching. John Wiley & Sons, 2018.
13. Bozkurt A, Bozkaya M. Evaluation Criteria for Interactive E-Books for Open and Distance Learning. Int Rev Res Open Distrib Learn. 2015; 16(5). https://doi.org/10.19173/irrodl.v16i5.2218.
14. Brousseau KR, Driver MJ, Eneroth KM, Larsson R. Adaptability: A critical capability for effective performance in contemporary work environments. Adv Dev Hum Resour. 2019; 21(2):188-202.
15. Cavanagh M, Chen B, Bathgate M, Fredrickson E, Hanauer DI. Pedagogical strategies that promote deep learning in science. CBE-Life Sciences Education. 2019; 18(4):61.
16. Caro F. Terminal Report about the utilization of interactive e-book. Studocu. Studocu; 2020. Available at: https://www.studocu.com/ph/document/bicol-university/bachelor-of-elementary-education/terminal-report-about-the-utilization-of-interactive-e-book/16851770.
17. Chang WC, Wu YT. Exploring the effectiveness of interactive e-books in engaging young children with reading. J Educ Technol Soc. 2018; 21(4):42-54.
18. Chen MP, Lee CH, Chen YH. An exploration of digital mathematical textbooks in Taiwan: A survey of undergraduate students' perceptions. Innov Educ Teach Int. 2019; 56(5):627-637.
19. Cheng YC, Yang CH. The effect of gamification with interactive e-book reading on Chinese as a foreign language learners' motivation and learning achievement. Educ Technol Res Dev. 2019; 67(3):651-667.
20. Çırakoğlu N, Toksoy SE, Reisoğlu İ. Designing, Developing, and Evaluating an Interactive E-Book Based on the Predict-Observe-Explain (POE) Method. J Form Des Learn. 2022. https://doi.org/10.1007/s41686-022-00071-3.
21. Cummings GE, Hughes AM, Tate K. The least learned lessons in management education. J Manag Educ. 2018; 42(2):220-245.
22. Dani V. 8 biggest reasons why teachers prefer ebooks in classrooms. Kitaboo. 2022. Retrieved February 23, 2023, from https://kitaboo.com/8-reasons-why-teachers-prefer-ebooks-in-classrooms/.
23. DeWitt J, Alias N, Siraj S. Low proficiency in mathematics among secondary students in Malaysia: Identifying the least learned topics and the causes. Int J Sci Math Educ. 2019; 17(6):1127-1143.
24. Fryer LK, Bovee HN. Using assessment as a tool to support learning: A practical guide for faculty. J Effective Teach. 2019; 19(2):20-35.
25. Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A, Rubin DB. Bayesian data analysis. CRC press; 2018.
26. Gonzalez-Fernandez B, Vazquez-Cano E, Gutierrez-Braojos C. Evaluating the effectiveness of an interactive textbook for learning technology. Educ Inf Technol. 2019; 24(4):2311-2328.
27. Guspatni G. Students' activities in, perceptions of and expectations for e-learning: A case study in Indonesia. Knowl Manag & E-Learn: An Int J. 2018; 10(1). Doi: 10.34105/j.kmel.201.10.006.
28. Harman M. Importance of eBooks in education - Kitaboo. Kitaboo. 2018. https://kitaboo.com/importance-of-ebooks-in-education/.
29. Havens C. Do book widgets help sell books? The Digital Reader. 2018. Retrieved from https://the-digital-reader.com/2018/10/01/do-book-widgets-help-sell-books/a.
30. Hiebert J, Grouws DA. The effects of classroom mathematics teaching on students' learning. In the Handbook of research on teaching. Routledge; 2017, 371-404.
31. Hopkins P. Learning with interactive electronic books. Impact Part My College, 2019. https://my.chartered.college/impact_article/learning-with-interactive-electronic-books/.
32. Hwang GJ, Lim KY. Effects of interactive e-books on enhancing student achievement: A meta-analysis. Educ Res Rev. 2020; 29:100295.
33. Kelleher JD, Tierney B. Data science: An introduction. CRC press, 2018.
34. Kim Y, Han H, Lee D. An empirical study on the effects of Kotobee as an ebook authoring tool in university courses. Educ Technol Res Dev. 2019; 67(2):445-467.
35. Kim D, Lee J. Effects of multimedia characteristics on cognitive and affective processing of information in interactive e-books. Comput Educ. 2018; 123:102-113.
36. Kim S, Lee J. Effects of interactive e-books on reading comprehension of students with dyslexia. J Educ Comput Res. 2020; 58(3):503-523.
37. Kurniawati N, Fauziyah F. Fostering students' engagement in synchronous learning using interactive web-based media. Indones EFL J. 2022; 8(1):13-22. https://doi.org/10.25134/ieflj.v8i1.5583.
38. Lai ER, Kritsonis WA. The evolution of teaching pedagogies: A literature review. J Hist Stud Educ. 2018; 30(2):47-67.
39. Li H, Li Y, Yang J. Investigating the usability of interactive e-books: The perspectives of university students. Interact Learn Environ. 2021; 29(2):192-205.
40. Li X, Zhang Y, Bonk CJ. Interactive e-books in higher education: A comprehensive meta-analysis. Educ Res Rev. 2020; 31:100341.
41. Lim BCY, Liu LWL, Chian Hou C. Investigating the Effects of Interactive E-Book towards Academic Achievement. Asian J Univ Educ. 2020; 16(3):78. https://doi.org/10.24191/ajue.v16i3.10272.
42. Liu B, Huang Z, An Y, Wu Q, Wang Z. Advances in data-driven decision making: big data analytics, machine learning, and statistical models. Comput Math Organ Theory. 2019; 25(1):1-15.
43. Liu C, Hwang GJ. Roles and research trends of touchscreen mobile devices in early childhood education: Review of journal publications from 2010 to 2019 based on the technology-enhanced learning model. Interact Learn Environ. 2023; 31(3):1683-1702.
44. Manalastas R, De Leon S. European Journal of Humanities and Educational Advancements (EJHEA) Development and evaluation of electronic instructional module in matter, 2021.

https://scholarzest.com/index.php/ejhea/article/download/1175/990/2290.
45. Mangen A, Velay JL. Learning from paper, learning from screens: Implications for reading comprehension. Int J Educ Res. 2020; 103:101620.
46. Meyer R, Hohenwarter M, Strasser W. Digital tools for mathematics education: Research results and experiences. J Math Educ. 2019; 12(1):1-12.
47. Montgomery DC, Jennings CL, Kulahci M. Introduction to time series analysis and forecasting. John Wiley & Sons; 2018.
48. Nielsen Norman Group. Best practices for book widgets. 2019. Retrieved from https://www.nngroup.com/articles/book-widgets-best-practices/.
49. Park Y, Son S, Kim C, Han I. The effect of mobile learning on students' satisfaction, engagement, and achievement. Int J Mob Learn Organ. 2018; 12(1):1-12.
50. Pew Research Center. Public libraries and technology: From "houses of knowledge" to "houses of access". 2018. Retrieved from https://www.pewresearch.org/internet/2018/09/13/public-libraries-and-technology-from-houses-of-knowledge-to-houses-of-access/.
51. PwC. The impact of book widgets in the publishing industry. 2018. Retrieved from https://www.pwc.com/us/en/library/data-driven-insights/book-widgets.html.
52. Rahim FR, Suherman DS, Muttaqiin A. Exploring the effectiveness of e-book for students on learning material: a literature review. The 2nd International Conference on Research and Learning of Physics. 2020; 1-8. https://doi.org/10.1088/1742-6596/1481/1/012105.
53. Rambe P, Rambe J. Investigating the use of augmented reality and Kotobee to enhance student engagement and understanding. Educ Technol Res Dev. 2019; 67(2):327-345.
54. Ramadhani VY, Khusniati M. Development of Interactive E-Books containing Virtual Laboratory to Improve Students' Motivation Learning. In Journal of Environmental and Science Education. 2022; 2(1):49-57. https://doi.org/10.15294/jese.v2i1.53125.
55. Retnoningsih A, Retnoningsih A, Irsadi A. Effectiveness of Interactive E-book Global Warming and Climate Change Integrated Socio Scientific Issues Peat Ecosystem. JPPIPA. 2021. Doi: 10.29303/jppipa.v7iSpecialIssue.1039.
56. Romero C, Ventura S, García E. Data mining in education. Wiley Interdiscip Rev: Data Mining Knowl Discov. 2019; 9(1):e1309.
57. Ross SM. A first course in probability. Pearson; 2018.
58. Salah RM. The Imact of Virtual Learning Environments on the Digitalization of Higher Education in the Kurdistan Region-Iraq. Sci J Univ Zakho. 2022. https://doi.org/10.25271/sjuoz.2022.10.3.875.
59. Sandy W. BookWidgets Review for Teachers | Common Sense Education. Www.commonsense.org. 2019. https://www.commonsense.org/education/reviews/book widgets.
60. Sari SY, Rahim FR, Sundari PD, Aulia F. The importance of e-books in improving students' skills in physics learning in the 21st century: a literature review. J Phys: Conf Ser, 2022. https://iopscience.iop.org/article/10.1088/1742-6596/2309/1/012061/pdf.
61. Setiyanigrum R, Susilaningsih E, Setyaningsih NH. Development of Interactive E-books on Plane Figures Materials to Improve Problem Solving Ability of Grade IV Students. Int J Res Rev. 2022; 9(2):297-307. https://doi.org/10.52403/ijrr.20220240.
62. Siano L, Potane J. Using Interactive E-books to Improve Students' Academic Achievement in Mathematics. UIJRT | United Int J Res Technol. 2022; 03(2582-6832):2582–6832. https://uijrt.com/articles/v3/i5/UIJRTV3I50006.pdf.
63. Sofia C, Biléu C. The Interactive Ebook as a Learning Tool: An application in the ICT discipline. file:///C:/Users/Lods/Downloads/Extended%20Abstract.pdf.
64. Sharma P, Kaur K. Gamification in education: A literature review. J Educ Technol. 2018; 15(1):39-50.
65. Shukla S, Das N, Chaturvedi N. Using Kotobee for interactive manual and guide creation in industry. Int J Eng Adv Tech. 2020; 9(1):1863-1868.
66. Sun L, Pan CE. Effects of the Application of Information Technology to E-Book Learning on Learning Motivation and Effectiveness. Front Psychol. 2021, 12. https://doi.org/10.3389/fpsyg.2021.752303.
67. Suprapto N, Tafauliyati T, Yanti KY. Development of e-book with Flip PDF Professional Based on Scientific Literacy. TEM J. 2022; 11(2):851-855. Doi: 10.18421/TEM112-44.
68. Suyatna A, Distrik IW, Herlina K, Suyanto E, Haryaningtias D. Developing interactive e-book of relativity theory to optimize self-directed learning and critical thinking skills. AIP Conf Proc. 2018; 2014(1):020065.
69. Wang F, Hannafin MJ. Theory-based design of instructional strategies. In Learning, design, and technology: An international compendium of theory, research, practice, and policy. Springer, 2019, 1-28.
70. Wang C, Lin TJ. Using interactive e-books to facilitate student learning: A computer science course case study. Interact Learn Environ. 2019; 27(8):1075-1093.
71. Weinhandl R, Houghton T, Lindenbauer E, Mayerhofer M, Lavicza Z, Hohenwarter M. Integrating Technologies Into Teaching and Learning Mathematics at the Beginning of Secondary Education in Austria. Eurasia J Math Sci Tech Ed. 2021; 17(12). https://doi.org/10.29333/ejmste/1148.
72. Wilson E. Here's How Interactive eBooks Elevate The eLearning Experience And Its Effectiveness. ELearning Industry. 2021. https://elearningindustry.com/how-interactive-ebooks-elevate-the-elearning-experience-and-effectiveness.
73. Wu HK, Huang YM. The effects of interactive e-books on elementary students' science learning. Interact Learn Environ. 2018; 26(1):110-122.
74. Yilmaz RM, Yesilyurt E. Technology-enhanced learning for students with learning disabilities: A systematic review. Educ Technol & Soc.
75. Zhang L, Li X. A Review of Recent Studies on Learning Pedagogy in Digital Learning Environments. J Educ Technol Dev Exch. 2021; 14(1):1-16.
76. Zhang X, Tlili A, Shubeck K, Hu X, Huang R, Zhu L. Teachers' adoption of an open and interactive e-book for teaching K-12 students Artificial Intelligence: a mixed methods inquiry. Smart Learn Environ. 2021; 8(1).

https://doi.org/10.1186/s40561-021-00176-5.
77. Zeng Y, Zhang X. The effects of multimedia interactive e-books on English as a foreign language learning. Educ Inf Technol. 2019; 24(2):1421-1438.