

Using Interactive E-books to Improve Students' Academic Achievement in Mathematics

Lordson Q. Siano¹ and Joel D. Potane²

^{1,2}Graduate School, Capitol University

²Cagayan de Oro City, Philippines

ORCID: ¹[0000-0003-0369-6137](https://orcid.org/0000-0003-0369-6137) and ²[0000-0003-0210-8149](https://orcid.org/0000-0003-0210-8149)

Email: ¹lordsonsiano2@gmail.com and ²potane.joel@g.cu.edu.ph

Abstract— The study explored the effectiveness of e-books in teaching Mathematics to improve students' academic achievement. Kotobee author and kotobee reader were used in the conduct of the study in one of the secondary schools in the Division of Cagayan de Oro City. The study used a one-group pretest-posttest design, involving quantitative and qualitative analyses. The kotobee author and reader, achievement test, and interviews were employed. Findings indicated that students achieved satisfactory level when exposed to the interactive e-book. There was a statistically significant difference in how well students did on their tests before and after. Students are motivated to learn when using an interactive e-book to enhance their knowledge. Students had a remarkable learning experience with the interactive e-book.

Keywords— academic achievement, interactive e-book, kotobee author, kotobee reader, mathematics learning.

I. INTRODUCTION

The Department of Education (DepEd) is committed to maintaining educational continuity in the face of COVID-19's challenges. Education must continue to provide hope and stability, normalize activities in the country, and help our students grow and develop. However, the health and safety of learners and school personnel are of utmost importance and must be protected at all times. As a result of the COVID-19 public health emergency, DepEd Order No. 012 was issued on June 19, 2020. A key program principle is to provide learning continuity through K-12 curriculum modifications, alignment of learning materials, different delivery modes, teacher and school leader training, and correct orientation of learners' parents or guardians.

Most countries have temporarily halted schools to stop the virus spreading and illnesses (Tria, 2020). Face-to-face interaction between students and teachers has also been suspended. The Philippines is transitioning to the new standard form of education, and educators and other stakeholders are actively involved in its success. The Department of Education implemented Modular Distance Learning to ensure continuity of education and

to ensure that every Filipino learner receives a quality education.

Distance learning is a learning delivery method that involves an instructor and students who are geographically separated. There are three types: MDL, ODL, and TV/Radio-based Instruction (Quinones, 2020).

In the Philippines, modular learning is the most popular. In a poll done by the Department of Education, parents of students enrolled this academic year favored learning through printed and digital modules (Bernardo, 2020). This is also for learners in remote locations where internet access is limited.

The teacher is in charge of monitoring student progress. Consistent follow-ups are observed and practiced in this routine. The teacher shall make home visits to students who require remediation or support (Llego, 2020). Printed Modules were delivered to students, parents, or guardians by the teachers or through the Local Government Officials, mainly in the rural areas. While in urban areas, most of the parents or guardians or any representatives would go to school to get the printed modules and brought back to home for the learners to answer the said modules.

Since education is no longer school-based, parents are educators' partners. Parents are key home facilitators. In modular learning, they connect and guide the child (FlipScience, 2020).

Modules encourage self-study. Using modules for instruction can help students develop stronger self-study or learning skills. Students actively learn the module's concepts. They learn responsibility through completing the module's tasks. The students' progress independently with little or no outside help. They are empowered as they learn to learn (Nardo, 2017). Other benefits of modular instruction include student choice and self-pacing, teacher and staff flexibility, and increased adaptation of instructional materials.

Distance learning requires technology solutions. A connected community can access a wide range of

content via online platforms, which are considered the most advanced.

On this aspect, one obvious limitation lies in the current stage of development of the ICT infrastructure. In the Global Connectivity Index published by Huawei, which annually ranks 79 nations based on factors including ICT investment, ICT maturity, and digital economic performance, the Philippines ranked 59th and is categorized as a “Starter.” Meanwhile, on the end-user side, there is the question of access to the platform and the availability of the appropriate gadgets.

Within the public-school system, 1,042,575 devices (desktops, laptops, tablets) are distributed across 44,155 or 93 percent of schools. Among these devices, 459,578 are laptops/tablets that may be brought home, which represents only 2 percent of total learners in the public schools. Some 22,645 or 48 percent of public schools have internet connections. Another 8,478 or 18 percent of public schools are located in areas with Internet Service Providers, but they have not yet connected.

Our daily operations are increasingly more reliant on technology. Whether in social life, business, research, etc., reliance on technology is increasing.

For the first time since the late 1990s, the spread and use of e-books in higher education has expanded globally (Shelburne, 2009). E-textbooks are a collection of informational texts created for study in a digital format (text, photos, graphics, audio, video, and/or animation) (Landoni & Hanlon, 2007). The e-book is a sophisticated technological invention that will eventually replace traditional paper books (Lynch, 2012; Shen, 2011; Lai & Chang, 2011). Although college students prefer traditional paper textbooks (Kimball et al., 2010; Letchumanan & Tarmizi, 2011), electronic textbooks provide many advantages over traditional paper textbooks, including screen text display.

With the advent of e-books, we are now using digital copies of our self-learning modules used in DepEd, how they help education efforts and how they may be made more effective.

Digital education provides many excellent tools. An interactive e-book has text, animations, audio files, videos, games, quizzes, book widgets, and more. This is all in one document, online or offline.

E-books can enhance how learners absorb their content due to the e-books' added features supporting higher interactivity and reach-ability.

Gamification in education also appears to have huge promise. Students struggle to remember information when learning is uninteresting. With an interactive platform, we can test our knowledge in real-world applications and thereby improve retention. Not replace, but amplify the educator's skills. It must solve a problem that no other approach has successfully solved. It should also provide instructors with fresh ways to engage students. To harness the benefits of educational technology, teachers must be familiar with the technologies and tools available.

Keeping in mind that not all students are equally tech-savvy You must set a lower benchmark for all students. Some examples are: All students must know (1) how to use the E-book Reader and (2) how to navigate and aggregate annotations.

In this way, teachers can extend the class into a virtual class in the form of blended learning in which students can solve and visualize video lectures and home works outside the classroom. This is especially interesting for learning Mathematics. If students can learn at home from watching video lectures and solving problems, time in class can be dedicated to exploring more motivating problem-solving. Math teachers have a difficult situation. Studying math is many times a cumbersome task. But this can be changed if the teacher takes advantage of the currently available technology. Students are surrounded by multiple devices, such as smartphones and tablets, which give them access to multiple readily available media. This is an opportunity for the teacher. Technology related to teaching/learning will have a vital role in the coming years in the education field.

The use of videos for teaching and learning is effective for visual and auditory learners as video and narration are less complicated than written explanations. Video recording is well suited for demonstrating basic concepts and problem-solving. It allows students to learn at their own pace and in their learning style. Video lectures are well adapted for classes with students who have different levels of knowledge of the subject. Some students can view the materials once and understand the subject well. Other students can view the videos several times to better understand the subject. This is an advantage over the traditional classroom, where the students often do not understand and do not ask to repeat the subject until they are able to understand.

With the number of students increasing in the class this is a vital tool to enable students to work at home and leave classroom time to implement problem-based learning methodologies and virtual learning classrooms.

By using today's flexible, interactive and mobile technologies with the appropriate pedagogies, we believe it is possible to have students more motivated in mathematics and expect a more creative response to the world problems that surround them. Moreover, information technology today has intuitive interfaces, is simple to use and is effective in the results. It allows teachers to produce personalized content and has a high motivational impact on students. Producing an e-book with materials used and prepared by the teacher is one such opportunity. We also believe that technology is accessible and easy to use by math teachers and students, and much more can be improved with further work done in the field.

Teaching thinking is now a must, and the focus is no longer on helping pupils learn knowledge, information, facts, or educational concepts. But developing thinking skills goes beyond their mental talents. For example, mathematicians can employ more exercises to help pupils strengthen their mathematical thinking skills. Studies in this field have shown that integrating teaching mathematics with technology and the internet improves students' thinking, mathematical achievement and concept attainment.

The teaching approach employed in the study is through an interactive e-book with book widgets and some interactive assessments, especially in pretest and posttest in Mathematics. The least mastered learning competencies in Mathematics in grade ten level were focused of the study. Improving the said competencies among students by exploring interactive e-books in teaching mathematics concepts in patterns and algebra specifically are the main reasons for conducting the study.

The level of students' proficiency and learning experience in Mathematics after being exposed to interactive e-books would be the indicators of the effectiveness of virtual learning. This study investigated the effect of interactive e-books on student's proficiency in Mathematics.

Research Questions

This study sought to answer the following problems:

1. What are the students' academic achievement levels using the interactive e-book?
2. Do the respondents' pretest and posttest scores differ significantly?
3. What are the students' learning experiences when exposed to Interactive E-book?

II. METHODOLOGY

The study utilized the one-group pretest-posttest design. There were ten (10) sections in grade ten (10) level for SY 2021-2022. Moreover, a simple random sampling technique was employed to select one (1) section in this research.

One (1) group of randomly selected online classes of Grade 10 students served as the study participants. Fifty (50) student participants were being involved in the study. The aforesaid group of online class in Grade 10 was involved in the study in order to test the effects of e-book when least mastered competencies in mathematics were delivered with the aid of Kotobee interactive E-book software to the proficiency in the knowledge and skills among Grade 10 students.

Kotobee software which contained image, gallery, link, anchor, questions, video, audio, audio sync, container widget, equation and 3D were used in the study. The participants were provided the google drive link for the interactive e-books. Students used a Kotobee Reader application to read the digital copies of self-learning modules (in eBooks forms) in Mathematics. Also, pretest-posttest and in-depth interviews were employed to determine the students' learning experience.

The contents of interactive e-books were based on the Most Essential Learning Competencies (MELCS) as prescribed by the Department of Education. The concepts were relevant to real-life situations to connect the ideas learned to the environment. The material contained overview of the lesson, pre-assessment, prior knowledge, presentation, concept development, activities, assessment, application, synthesis and post-assessment. These contents of the digital copies of self-learning modules were interactive using different activities through widgets online and offline. Moreover, the video lessons were embedded in the content of every lesson and so with different youtube links and gallery of pictures for further references in learning mathematics. With the notes in every module, the teacher knew about students' learning experience. The Kotobee interactive E-book contained activities, assessment and application through widgets using online and offline where students explored and answered different exercises in an interactive and fun way. Furthermore, answer keys to questions and information in each lesson were included.

The pretest-posttest was a 50-item test embedded in the Kotobee interactive E-book. The tests were designed to measure the proficiency of Grade 10 students in the least mastered competencies in Mathematics. The comprehension and readability levels in each item were

given full consideration. The test was tried out to a group of fifty (50) students.

The data in the pretest-posttest were analyzed and interpreted using frequency and percentages, while z-test at $p = 0.05$ level of significance were used to determine the significant difference in the achievement test scores of students. Furthermore, daily observations and interview to the students were documented and recorded.

In every correct answer in the achievement test was given one (1) point, thus, the perfect score was 50 because the total number of items in the achievement test was 50. A range was adapted in assigning the equivalent achievement levels to the scores obtained by

the students: 41-50 (Outstanding), 31-40 (Very Satisfactory), 21-30 (Satisfactory), 11-20 (Unsatisfactory), and 0-10 (Failed/Needs Improvement).

III. RESULTS AND DISCUSSION

Academic Achievement Level of Students in Digital Copies of Self-Learning Modules through Kotobee Interactive E-book

The data in table 1 show the academic achievement level of students in one section of the school in grade 10 level with the use of kotobee interactive e-book as intervention. The data showed that students have a moderate level of academic achievement with implementing the intervention.

Table 1: Academic Achievement Level of Students in the Pretest and Posttest in One Section of Grade Ten Level using Interactive E-book

One Section Pretest			One Section Posttest		
Achievement level	f	%	Achievement level	f	%
Failed	9	18	Failed	0	0
Unsatisfactory	21	42	Unsatisfactory	13	26
Satisfactory	17	34	Satisfactory	26	52
Very Satisfactory	3	6	Very Satisfactory	7	14
Outstanding	0	0	Outstanding	4	8
Total	50	100	Total	50	100

It revealed that the pretest scores of students were almost equally distributed. It is also revealed that nine student-respondents failed during pretest as expected since they did not know the lessons well. It was noticed that no one from the students achieved an outstanding rating in the pretest. Moreover, the posttest scores of students revealed that no one got the failing remarks since most of them already knew the lessons. This implies that somehow the student-respondents had mastered the

lessons for thirty-seven of them got the satisfactory to outstanding achievement level during the posttest.

As shown in Table 2, students had unsatisfactory achievement level prior the intervention. They were slightly proficient in the knowledge and skills in mathematics concepts and principles. The data also show that pretest scores of students were heterogeneously distributed.

Table 2: Mean, Standard Deviation and the Academic Achievement Level of Students in One Section of Grade Ten Level using Interactive E-book

	Mean	SD	Desc
Pretest	18.96	7.42	US
Posttest	26.18	7.71	S

As gleaned in Table 2, the kotobee interactive e-book group students achieved higher scores in the posttest than in the pretest. It implies that students gained better understanding after they were used to the digital copies of Self-Learning Material (SLM) in mathematics via kotobee interactive e-book. It was evident that students exposed to kotobee interactive e-book have satisfactory achievement level. Students became moderately proficient in the knowledge and skills in mathematics

particularly in sequence topics through an offline mode widget and with the aid of video lessons and interactive assessments through questionnaires. The said application was installed in the individual gadget like cellular phones or computer so that everyone could do and answer the interactive e-book without internet connection. Students could do and answer their assessment tasks based on their own pacing and availability.

This study disclosed the potential of kotobee interactive e-book as an alternative teaching approach in teaching-learning experience in mathematics. It directly provides visual comprehension of the mathematics concepts. Karlin (2013) found that Kotobee is a great tool for teachers wishing to produce digital books and make their classroom content more engaging. The ability to incorporate interactive widgets from sites like Bookry opens up new possibilities, as does the ability to publish your book in many formats.

Using interactive e-books has helped both educational designers and teachers overcome the limitations of paper books. As well as having the same characteristics as paper books, they also include unique features and characteristics that provide an interactive learning environment. So, it was vital to organize these books so that the learner could browse and keep them. Linking relevant instructional design features to educational theory helps achieve this. To achieve active learning, the produced interactive eBooks will be used for instructional reasons (Ibrahim, 2011).

Directed control style is an essential aspect in e-learning and interactive e-book design. Control implies knowing what you're using, how to search, where you are, and your alternatives (Rose, 2011). Morineau (2005) and Rose (2011) cite the lack of control and directing techniques while browsing, as well as the inability to determine the electronic material environment and learners' features and levels. Patricia (2005) also stresses the need of control and direction features in e-books to

enable readers go ahead and backward through the book's pages. Among the control tools for e-books are: linkages; lists; cognitive maps; content tables; image collections; timelines; search engines.

It is difficult to use linear control style in interactive eBooks, so Yoon (2005) recommends using non-linear control style using two tools, namely cognitive maps and frame menus, which help the user navigate the interactive e-book freely and so contribute to different learning outcomes.

Academic success is one of the most important learning outcomes that show the true image of the usefulness of interactive e-books. Thus, it is vital to evaluate the effectiveness of interactive books in improving student academic attainment to standard paper books (Flashman, 2012).

Comparison of the Academic Achievement of Students Using Kotobee Interactive E-book

The data presented in Table 3 compares students' pretest and posttest scores in one group. It was subjected to Wilcoxon signed-rank test for the independent sample to test the significant difference between scores. The data disclosed a significant difference in students' pretest and post-test scores, as shown by the computed p-value, which is less than the level of significance at 0.05. The null hypothesis which stated that there is no significant difference in the academic achievement in mathematics between the pretest and posttest scores of students is rejected.

Table 3: Comparison between the pretest and posttest scores of students in One Group using Kotobee Interactive E-book

Mean	SD	Wilcoxon	Statistic	p-value	Decision
Pretest	18.96	7.42	27.0	0.000	Reject H ₀
Posttest	26.18	7.71			

$\alpha = 0.05$ level of significance

The result showed that an interactive e-book via kotobee author with developed and validated video lessons significantly improved students' academic achievement. Based on the daily observations of the teacher-researcher who handled the kotobee group, students using interactive e-book classes were very eager to learn and very active, interested, and highly motivated in performing their digital modules, especially in their digital modules answering assessment portions of every module found in the said application. Moreover, Chen and Jang (2013) claim that e-books are a vital learning platform that may help students learn new skills online. Maynard (2005) examined how much children learn from electronic text versus printed material. People who used an electronic textbook (e-book) performed better

on comprehension tests than people who used a paper textbook.

The e-book gives opportunities for discovery to find new ways to interact with information because it is a media format that contains audio, image, film, and interactive multimedia connections that can be read or watched in computers and similar devices (Hatipoglu & Tosun, 2012). In addition to the integration between the interactive e-book and the different teaching strategies used by teachers in the classroom contributed to increasing the success of the interactive e-book in achieving the study's objectives up to these results. Many studies have shown that interaction is vital in creating a great e-learning environment. E-books allow

students to communicate with other students and teachers via written and visual communication. Moreover, several researchers have pointed out that e-books for social interaction constitute an important role in the emergence of internet usage (Buckley & Tritt, 2011).

Students' Learning Experiences when Exposed to the Digital Copies of Self-Learning Modules (SLMs) through Interactive E-book via Kotobee Author Application

Based on the results of the focused group discussions (FGD) emerged the following themes: Fun Kotobee Learning Experience, Creating New Opportunities and Quick Learning; and Eagerness in Learning Mathematics Skills.

Fun Kotobee Learning Experience. The students claimed that they had fun and enjoyed every learning assessment their teacher gave aligned with the interactive e-book via kotobee author. The key informants shared that:

“it's fun. I liked the part where I had to choose which of the assessment questions I wanted to respond to. I enjoyed using it because you can learn easily because it's digital and also very easy to answer.” (Participant #12)

The responses of students suggested that they have the positive views towards kotobee interactive e-book. Based on observations by the teacher-researcher, even students who did not take up ICT became interested in learning because they found out that digital copies of modules using interactive e-book via kotobee author application was enjoyable.

Learning Opportunities and Desired Learning. Kotobee interactive e-book improved students' academic achievement. All respondents revealed that they have explored new things on the different interactive links and attachments and featured found in every module in learning mathematics concepts in various types of sequence, polynomial expressions and polynomial equations. The students divulged that:

“the kotobee reader app really works well and very easy to use. I could easily access the files that you've sent me. It only takes seconds until the file is uploaded to the app. I explored the e-book and I've seen so many math new topics. I saw some very informative photos that included formulas and how to solve mathematical word problems. It helps students to learn faster.” (Participant #29)

User-friendly Kotobee app. The kotobee interactive e-book provided a very friendly environment for students, manifested in students' participation and making decisions based on their observations. The students' output showed that they were able to solve problems that improved their higher-order thinking skills. The responses of FGD participants stressed that:

“it's very easy to use. It will improve my math skills, and I had to read a lot and calculate or solve a lot. It really helps to gain more points for our grades. I could improve my knowledge about the lesson.” (Participant #36)

Technology enhances math and science training. Engaging and interactive media can boost the learning process and bring concepts to life. We may also provide additional assistance to meet individual student needs (Kristine Scharaldi, 2000). Many researches found that interactive media was more successful than traditional non-ICT instruction in improving students' cognitive learning. The Kotobee interactive e-book fosters conceptual understanding, mathematical mastery, and higher-order thinking. Thus, continual use of interactive e-books in class increases student learning and achievement.

IV. CONCLUSION

Using digital copies of Self-Learning Modules (interactive e-book) via kotobee reader application promotes satisfactory academic achievement among students. Thus, e-book could be used by mathematics teachers to facilitate change in their classes, especially those who conducted the blended learning modality, specifically on online delivery of instruction. With the significant difference in students' academic achievement in one section (kotobee group), an interactive e-book could be used to improve conceptual comprehension, process, cognitive, and technical abilities in mathematics instruction. The interactive e-book, accessed via the kotobee reader application, may also assist mathematics teachers in enhancing mathematics teaching. Additionally, this might be one of the educational tools utilized to promote positive changes in students' learning and experience.

ACKNOWLEDGMENT

The journey of completing this study has created an abundance of gratitude for the people who gave him the encouragement and support and essentially the confidence in him. He is humbled by the outpouring of the unconditional love and honored to share this accomplishment with each of the following individuals:

To the DepEd family who made things happen. Many heartfelt thanks to Dr. Cherry Mae L. Limbaco-Reyes, CESO V, for allowing the conduct of this study. The principal who accommodated warmly his attention, Mr. Ronaldo D. Auman, for the assistance and encouragement. His appreciation as well as to the teachers in supporting him and believing in him to the best of his abilities.

Finally, and most importantly, his acknowledgment to GOD. HE opens a gateway with unimaginable blessing – ALL THE TIME. Thank you, JESUS, or the grace and endurance to run the race and the strength to reach his goal.

REFERENCES

- [1] Bernardo, J. (2020, July 30). Modular learning most preferred parents: DepEd. ABS-CBN News. <https://news.abs-cbn.com/news/07/30/20/modular-learning-most-preferred-by-parentsdeped>
- [2] Buckley, M., & Tritt, D. (2011). E-book approval plans: integration to meet user needs. *Computers in Libraries*, 31(3), 15-18.
- [3] Chen, H. Y. & Jang, S.J. (2013). Exploring the reasons for using electric books and technologic pedagogical and content knowledge of Taiwanese elementary mathematics and science teachers.
- [4] Flashman & Jennifer (2012). Academic Achievement and Its Impact on Friend Dynamics. *Journal Articles; Reports - Evaluative*, 85(1), PP.61-80.
- [5] FlipScience. (2020, October 5). ‘Tagapagdaloy’: How Filipino parents can help ensure successful modular distance learning. FlipScience - Top Philippine Science News and Features for the Inquisitive Filipino. <https://www.flipscience.ph/news/features-news/tagapagdaloymodular-distance-learning/>
- [6] Hatipoglu N. & Tosun N. (2012). The design of renewable and interactive e-book template for e-learning environments. *Online Journal of Communication and Media Technologies*. 2 (2), 126- 14
- [8] Ibrahim, Magda Anwar, (2011). The Effectiveness of the Open-Source Ebook in Achieving Efficient Learning and the Continuity of its Impact. Cairo: Helwan University
- [9] Landoni, M., Diaz, P. (2003). “E-education: design and evaluation for teaching and learning”. *Journal of Digital Information*, 3(4).
- [10] Letchumanan, M., and Tarmizi, R. A. (2011). “E-book utilization among mathematics students of University Putra Malaysia(UPM)”. *Library Hi Tech*, 29(1), 109- 121.
- [11] Llego, MA. (n.d). DepEd Learning Delivery Modalities for School Year 2020-2021. TeacherPh. <https://www.teacherph.com/deped-learning-delivery-modalities/>
- [12] Maynard, S.(2005). Can electronic textbooks help children to learn? *The Electronic Library*, 23(1), 103.
- [13] Morineau, T., Blanche, C., Tobin, L., & Guegen, N. (2005). The emergence of the contextual role of the e-book in cognitive processes through an ecological and functional analysis. *International Journal of Human-Computer Studies*, 62(3), 29-348.
- [14] Nardo, M. T. B. (2017, October 20). Modular Instruction Enhances Learner Autonomy. Sciepub. <http://pubs.sciepub.com/education/5/10/3/index.html>
- [15] Patricia, M. & Michael, D. (2005). The effects of spatial layout on relationships between performance, path styles and mental representation in a hypermedia information search task, *Interactive Technology & Smart Education*, 2: 31—45.
- [16] Quinones, M. T. (2020, July 3). DepEd clarifies blended, distance learning modalities for SY 2020-2021. Philippine Information Agency. <https://pia.gov.ph/news/articles/1046619>
- [17] Rose, E. (2011). The phenomenology of on-screen reading: University students’ lived experience of digitized text. *British Journal of Educational Technology*, 42(3). 515-526.
- [18] Shelburne, W.A. (2009). “E-book usage in an academic library: user attitudes and behaviors”. *Library Collections, Acquisitions, and Technical Services*, Vol. 33 Nos 2/3, pp. 59-72.
- [19] Tria, J. Z. (2020, June 3). The COVID-19 Pandemic through the Lens of Education in the Philippines: The New Normal. ResearchGate. https://www.researchgate.net/publication/341981898_The_COVID-19_Pandemic_through_the_Lens_of_Education_in_the_Philippines_The_New_Normal