



The effect of using interactive e-books on students' mastery of learning competencies in science 9

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Received: 12 August 2022

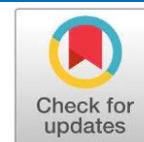
Accepted: 24 September 2022

Published: 30 September 2022

Abstract: Even in the midst of the COVID-19 pandemic, learning has to continue. With this, different learning modalities were employed, and different teaching strategies were explored. This research investigated the effect of using interactive e-books on students' mastery of learning competencies in science 9. Explanatory Sequential Mixed Methods Research Design was used wherein the quantitative data were gathered and analyzed first then followed by the collection and analysis of qualitative data. The participants were 17 students from the control group and another 17 from the experimental group, who were selected through purposive sampling. The control group was employed with two-way radio-guided modular distance learning modality while the experimental group utilized the developed interactive e-books. Findings revealed that the utilization of e-books has significantly improved the mastery level of the students. In addition, e-book utilization does not present any learning differences when compared to the two-way radio-guided modular distance learning modality indicating that this strategy is as effective as the two-way radio-guided instruction. The improvement in the mastery level of the students could be attributed to the positive feedback of the users on the interactive e-books, which include user satisfaction, clarity of multimedia, playability of e-books, and benefits of using e-books. However, some students have experienced minor difficulty with the installation of e-books.

Keywords: E-book utilization, Distance learning, Teaching strategy.

How to cite: Ananayo, S.M. (2022). The effect of using interactive e-books on students' mastery of learning competencies in science 9. *Journal of Science and Education (JSE)*, 3(1): 51-61. <https://doi.org/10.56003/jse.v3i1.146>



INTRODUCTION

The emergence of Coronavirus Disease 2019 (COVID-19) has greatly affected the normal operations of the education sector (Schleicher, 2020; Toquero, 2020), since physical distancing has become a requirement (World Health Organization, 2021). The pandemic has resulted in the closure of schools for face-to-face teacher-student interaction (Buchanan et al., 2022).

However, despite the pandemic, DepEd Chief Leonor Magtolis-Briones asserted that education must continue, hence, introduced the Basic Education Learning Continuity Plan (BELCP) as the department's response to the challenges posed by COVID-19. Under the Basic Education Learning Continuity Plan (BELCP), the K to 12 curriculum was streamlined into the Most Essential Learning Competencies (MELCs), reducing the number of learning competencies by 60%. In addition, a series of webinars and training was conducted for teachers and school leaders, parents and guardians were oriented, multiple learning delivery modalities were deployed, and contextualized learning resources were crafted as preparations for distance education (Department of Education, 2020).



The shift to distance education has resulted in the use of gadgets such as mobile phones and other devices in the teaching-learning process. According to [Tanil & Yong \(2020\)](#), mobile phones have evolved from basic communicative functions (call and text only) to being a computer-replacement device - used for web browsing, games, instant communication on social media platforms, and work-related productivity tools, e.g., word processing - making it useful in learning. Further, according to [\(Statista Research Department, 2022\)](#), 6.648 billion people worldwide own a smartphone wherein 41.31 million are Filipinos.

The use of mobile phones offers advantages in education such as the ability to share knowledge, the development of critical thinking, participatory learning, problem-solving, and the development of communication skills [\(Abidin & Tho, 2018\)](#). Mobile learning enables learners to access educational materials anywhere and anytime, therefore, mobile technology seems to be very attractive to learners and usable in the learning process [\(Lan & Sie, 2010\)](#). [Gan & Balakrishnan \(2014\)](#) also identified that the determinants that can enhance teacher-student interactivity through mobile learning were ease of use, self-efficacy, and enjoyment. [Mohammadi et al. \(2020\)](#) also mentioned that mobile phone as teaching aid enhances participation in the teaching-learning process, is useful as a supplementary teaching aid, enables the management and planning of the teaching process, and perceived by the students to be essential. [Enayati et al. \(2014\)](#), as cited in [Mohammadi et al. \(2020\)](#), also conducted a study on the use of mobile phones in providing educational content to students. The results indicated that transferring course materials via mobile phones and text messages is effective in learning.

During the pandemic, students used their mobile phones for online learning [\(Dolgunsöz & Yıldırım, 2021; Oguntuase & Bakare, 2022\)](#). However, many children and adolescents also used their mobile phones for video gaming to protect their mental health from the effects of the lockdown [\(Barr & Copeland-Stewart, 2022; Donati et al., 2021\)](#). In the Philippines, 29.9 million adolescents were recorded to be addicted to online gaming [\(Labana et al., 2020\)](#). Aside from gaming addiction, adolescents have also increased their use of social media sites and streaming services [\(Fernandes et al., 2020\)](#). Therefore, other than online learning, mobile phones were used for personal purposes. Hence, the capabilities and use of mobile phones must be maximized in education for optimum learning outcomes.

The maximization can be through the use of interactive e-books. The following are the features of interactive e-books: (a) Contents are accessed offline; (b) New words/phrases are linked to further descriptions or definitions for better understanding; (c) Images are inserted to support concepts; (d) Audios are included for students to listen to; (e) Videos are included for students to play and replay; and (f) Interactive quizzes are incorporated to track and evaluate learning progress. Students could check immediately their scores and could always retake the quiz.

The use of e-books is anchored on the e-learning theory [\(David, 2015; Wang, 2012\)](#) as cited in [\(He, 2020\)](#). According to [Wang \(2012\)](#) as cited in [\(He, 2020\)](#), the e-learning theory is composed of principles that can be integrated into the instructional design which demonstrate “how educational technology can be used

and designed to promote effective learning”. These principles include (1) Multimedia principle: using two formats of audio, visual, and text instead of using one; (2) Modality principle: explaining visual content with audio narration instead of on-screen text; and (3) Learner control principle: allowing the learner to control their learning pace.

Hence, utilizing interactive e-books in the teaching-learning process could be a great potential in times of crisis. During the conduct of the Program for International Student Assessment (PISA) in 2018, the Philippines ranked second to last place among the 79 participating countries in Science (OECD, 2018) indicating that Science achievement is low. In this time wherein learning is distant, maybe the use of e-books could help in achieving higher learning outcomes. This research aimed to determine the effect of the developed e-books on students’ mastery of learning competencies in science 9. This study likewise explored the students’ feedback on the e-books and the challenges met while using the e-books.

METHOD

This study utilized the Explanatory Sequential Mixed Methods Research Design, which is a two-phase mixed methods design. This design started with the collection and analysis of quantitative data which is followed by the subsequent collection and analysis of qualitative data (Creswell et al., 2006). The quantitative part is the main research which was conducted through an assessment (pretest/posttest) to determine the effectiveness of a new teaching strategy (e-book utilization) in enhancing students’ achievement, comparing it to another teaching strategy currently being used. After the collection of quantitative data, the secondary qualitative research examined the students’ feedback regarding the new teaching strategy including challenges encountered during its implementation.

The instrument that was used for the quantitative part of this study was a Pre-test/Post-test. Questions in the instrument were adopted from DepEd-issued textbooks and modules aligned with the chosen competencies, some questions were researcher-made. The pretest/posttest was originally composed of 50 items multiple choice questions. The researcher presented the test to a group of science experts (three Science teachers and one Science Master Teacher) in order to determine the validity of the tool. The percentage of agreement among experts was 93% which manifested validity of the test. The instrument was also pilot tested on ten (10) students who finished the lessons last year in order to measure the reliability of the test and to determine the coefficients of difficulty and discrimination. The Cronbach’s Alpha coefficient for the test was 0.84 which is relatively good for a classroom exam. It satisfied the reliability coefficient requirement for a classroom exam which is at least .70 (Wells & Wollack, 2003). Though the test was reliable, it was reduced to 40 items after eliminating the five most difficult and five easiest items through item analysis. On the qualitative part, the interview focused on the questions, “What can you say about the e-books that you used?” and “What challenges did you encounter while using the e-books?”.

The researcher sought approval from the school head, district, division, and regional leaders for the conduct of this research. Then the researcher identified the participants in this study. The respondents were

the 34 enrollees in Grade 9 for the school year 2021-2022. 17 students were purposively selected to compose the experimental group, that is, all 17 learners possess android phones required for learning through e-books. Another 17 learners were selected to comprise the control group that does not have android phones. Even if the respondents were selected this way, the researcher ensured that the two groups have the same characteristics except for the presence of gadgets. The researcher first determined the fast learners and the average learners. Then the researcher selected the fast learners that own gadgets (which composed the experimental group) and separated them from the fast learners that do not have gadgets (which composed the control group). The same process was done with the average learners. Generally, the two groups were composed of an equal number of fast and average learners.

Before conducting the experiment, the two groups (experimental and control) were pre-tested to examine and identify variables that might affect the objectivity of the study. T-test results in Table 1 show that there is no significant difference between the average initial ability of the students in the control group and the experimental group. It is therefore assumed that the two groups have almost the same cognitive level before the implementation of the treatment and the two groups are eligible for comparison after the treatment (e-books).

Table 1. Independent t-test for the pre-test

Group	Population	Mean	Standar Deviation	Mean Difference	Computed t	df	p
Control	17	10.58	1.50	0.47	-.873	32	.389
Experiment	17	11.05	1.63				

After the conduct of the pre-test, the developed e-books were utilized by the experimental group while the blended learning modality (two-way radio-guided modular distance learning modality) was employed to the control group during the given period for science 9 as reflected in the class program. This setup took place for the whole three weeks duration of the implementation.

For the experimental group, the e-books were shared to the phones of the students via the shareit app and Google drive. The e-books were embedded with different learning media such as text with images, links, audio, videos, and interactive quizzes and activities. During the days of delivering the specific lessons, the teacher-researcher gave instructions as to what sections in the e-books were to be accessed by the students through messenger. These sections include the Introductory section; Pre-assessment section; Lesson Section which is divided into different subsections such as Let's Try This, Let's Study, Let's Watch This, Let's Remember, Let's Listen to This, and Let's See What You Have Learned; and the Reference Section. The e-books covered the least mastered most essential learning competencies (MELCs) 1) explain how different factors affect the climate of an area, and 2) describe certain climatic phenomena that occur at the global level.

After the implementation, the learners underwent the same-reshuffled posttest to see if there is a significant change in their scores. The researcher also conducted debriefing activities to ensure the reliability

of test results. Data gathered through the result of the pre-test/post-test were tabulated and organized which facilitated the analysis and interpretation of data. Mean, SD, dependent t-test, independent t-test, and Braun & Clark's thematic analysis were used in the analysis of data. Quantitative data analysis was done by using IBM SPSS Statistics 21.

The participants from the experimental group were also interviewed through messenger to gather their feedback on the intervention and the challenges they encountered while using the e-books. Qualitative data gathered were from audio recordings of conversations between the students and the researcher, and copies of students' replies via messenger. The interviews were transcribed verbatim. Answers that are in Filipino were also translated into English. Thematic analysis was performed using Braun & Clark's six steps (Maguire & Delahunt, 2017). Open coding was applied wherein codes were developed and were modified as the researcher worked through the coding process. This was initially done by hand. The researcher also used Microsoft Excel by Bree & Gallagher (2016) to aid in the identification of themes.

RESULTS AND DISCUSSION

Tests for normality and homogeneity were first conducted. Shapiro-Wilk test was used with a significance value of 0.05 to determine the normality of data distribution (Van den Berg, n. d.) while Levene's test was used to determine if the two groups have the same variance.

Table 2. Result of Data Normality Test

	Group	df	Sig.	Interpretation
Pretest	Control	17	.124	Normally Distributed
	Experiment	17	.576	
Posttest	Control	17	.394	
	Experiment	17	.343	

Based on the table, it can be seen that in the pre-test, the Sig. value of the control group is .124 while the experimental group obtained .576. In the post-test, the control group obtained a Sig. value of .394, while the experimental group obtained .343. These values mean that the data on the pre-test and post-test scores of both the control and the experimental group were normally distributed.

Table 3. Result of Homogeneity Test

	F	Sig.	Interpretation
Pretest	.079	.780	Homogenous
Posttest	.030	.864	

Table 3 revealed that the obtained data for the homogeneity test of the pre-test is .780. This indicates that the pre-test data of the two groups are homogenous. The same result was obtained from the post-test. The two groups are homogenous through the Sig. value of .864.

Table 4. Significant difference between the mean pretest and post-test scores of students in the control and experimental group

Group	Mean/%	Standar Deviation	Mean Difference	Computed t	df	p
Control group (Blended)						
Pretest	10.58(26.47%)	1.50	24.59	-35.016	16	.000
Posttest	35.17(87.94%)	2.03				
Experimental group (E-books)						
Pretest	11.05(27.64%)	1.63	23.64	-65.106	16	.000
Posttest	34.70 (86.76%)	2.08				

The table 4 reflected the performance of the control and experimental groups before and after the utilization of e-books. Before the intervention was given, the two groups have very low mean scores of 10.58 (control group) and 11.05 (experimental group) with mean percentage scores of 26.47 and 27.64 respectively. After the implementation of the e-books, the mean score of the control group increased (35.17/87.94) which is described as closely approximating mastery. The same is true with the experimental group (34.70/86.76) which is also described as closely approximating mastery.

For the control group, the mean posttest score of 35.17 yielded a mean difference of 24.59 from the pretest score of 10.58. The t-test computed a value of -35.016 and a p-value of 0.000 at 0.05 level of significance. It can be determined that the increase in the performance of the students exposed to the blended learning modality is significant. This means that the two-way radio-guided modular distance learning modality is an effective way for increasing students' scores.

For the experimental group, a mean difference of 23.64 was obtained from the mean posttest (34.70) and pretest (11.05) scores of the students. The t-test revealed that this difference is significant through the t-value (-65.106) and p-value (0.000). It can therefore be said that the use of e-books is also an effective learning strategy to improve the scores of the students.

The result in the experimental group is similar to the results of previous studies. The study by [Sari & Mariah \(2019\)](#) found that the use of sea-based digital learning eBook increased learning outcomes on the subject Cookies and Candies. [Asrowi et al. \(2019\)](#) also concluded that interactive e-book is effective to be used to improve the students' knowledge of the social subject in the seventh class. Mohammed & Rahman (2015) also revealed that there is a significant difference between the academic achievement of the study groups who studied computer education in favor of the experimental group who studied through e-books. Further, [Stirling & Birt \(2014\)](#) noted that the use of e-books increased the marks of the students in gross anatomy.

The result could be because the use of interactive e-books is suited to the characteristics of students nowadays as they are techno-savvy and have a high interest in using gadgets ([Ananth Indrakanti, Milan Chutake, Stephen Prouty, Venkat Sundaranatha, 2022](#)). In addition, the e-books were enriched with different media (links, text with images, audio and videos) that helped the students learn the concepts. Another feature of the e-book is the presence of interactive activities. This feature aims to help the students assess how much

they have learned but at the same time could allow them to master the concepts. They can answer the questions provided in the e-books and know the score they have obtained immediately. If they get a low score in the activity, they can always review the concepts and could always retake the interactive activities, anytime and anywhere. [Asrowi et al. \(2019\)](#) stated that students pay more attention to the lesson and the lesson becomes more interesting when instructors use various multimedia tools.

Table 5. Significant difference between the post-test scores of students from the experimental and control groups

Group	Population	Mean	Standar Deviation	Mean Difference	Computed t	df	p
Control	17	35.17	2.03	0.47	-.666	32	.510
Experiment	17	34.70	2.08				

Table 5 shows the statistical data for comparing the mean scores of the students who were exposed to the e-books (experimental) and those who were exposed to the blended learning modality (control). The computed t is .666 while the p-value is .510. These values indicate that the posttest scores of the two groups have no significant difference. It can therefore be said that the two learning modalities have the same effect on students' learning achievement. The use of e-books is as effective as the blended learning modality when it comes to improving students' academic performance in this time of pandemic.

In the blended learning modality, the teacher teaches the students just like in the old normal but through the use of two-way radios. In this modality, there is an interaction between the teacher and the students on air, and the students could always ask for clarifications/explanations on unclear parts of the lesson. On the other hand, e-book as an independent resource for students provides a new experience for them. E-books can attract, motivate, gather the student's attention, and perseverance in learning (Roskos et al., 2017) as cited in [Asrowi et al. \(2019\)](#). Hasbiyati & Khusnah (2017) as cited in [Asrowi et al. \(2019\)](#) also revealed that e-book utilization can increase learning interest very well and can improve students' learning outcomes. Aside from being able to improve students' learning outcomes, the use of interactive e-books also encourages teachers to have creativity in providing learning materials suitable for their students' needs ([Asrowi et al., 2019](#)).

Table 6. Themes regarding Students' Feedback on the E-books

Themes	Sample transcripts gathered from the interview
User satisfaction	<ul style="list-style-type: none"> • I enjoyed using the e-books (Student C). • I enjoyed playing the activities especially when I get high scores (Student L).
Clarity of multimedia	<ul style="list-style-type: none"> • Texts, and interactive activities were clearly stated and easy to understand (M). • Audios and videos were clear and easy to understand (Stud L).
Playability of e-books	<ul style="list-style-type: none"> • Videos, audios and activities were easy to play (Stud D). • The e-books were easy to open, and it was easy to swipe to the next lesson (G).
Benefits of using e-books	<ul style="list-style-type: none"> • The e-books are useful and informative. It has colored pictures, sounds, videos and quizzes (Stud C) • It was easy for me to study the lessons through the e-books (Stud Q). • I can open the e-books anytime and anywhere that I want because it's already installed in my phone (Stud E).

Feedback from the students on the e-books they used identified four (4) themes which were user satisfaction, clarity of multimedia, playability of e-books, and practical benefits of using e-books. In general, participants' views about the quality and use of e-books were positive. The students enjoyed using the e-books as well as playing the embedded activities. They also perceived that the texts, interactive activities, audios, and videos were clearly stated and easy to understand. Students also found the e-books useful and informative, easy to access, and easy to navigate.

The results of the interview supported the findings of [Stirling & Birt \(2014\)](#) who revealed that the use of e-books resulted in a strong positive user experience in teaching the gross anatomy of the heart and great vessels. It also reinforced the study of [Morris & Lambe \(2017\)](#) who found out that the majority of the participants (over 70%) indicated that e-books were beneficial to their learning. However, the result is in contrast with the study of [Hsieh & Huang \(2020\)](#) who reported that the use of e-books was not perceived as particularly beneficial for learning.

In this study, the e-books used were compliant with the e-learning theory's principles of multimedia, modality, and learner control (Wang, 2012) as cited in [He \(2020\)](#), which could have contributed to the positive views and feedback of the students. According to Sprague (2008), Hunter Abram (2010), Paxhia (2011), and Daniel (2013) as cited in [Alshaya & Oyaid \(2017\)](#), the employment of multimedia tools (from text with images to audio and videos and interactive activities), can attract the attention of the students and their sense of enjoying the thrill during learning and can make learning more interesting and fun.

Table 7. Challenge met by the students regarding the use of e-books

Themes	Sample transcripts gathered from the interview
Difficult installation	I had a difficulty in the installation of e-books because my phone storage was nearly full, which I did not know at first. I even went to school to ask my teacher about it. It was solved when some of my videos were deleted. (Stud D)

Only one theme emerged for the challenges met by the students during the implementation of the intervention. A few of the respondents agreed on one difficulty which is the difficult installation of e-books when phones are nearly full. This could be because the e-books that were distributed have large file sizes, hence, require large storage area on phones.

CONCLUSION

The utilization of interactive e-books in science learning is as effective as the two-way radio-guided modular distance learning modality when it comes to improving the mastery level of students on selected competencies in Science 9 as indicated by the significant increase in the scores of the students. In support to this, feedback from students on the use of e-books were generally positive which include user satisfaction, clarity of multimedia, playability of e-books, and practical benefits of using e-books. These qualitative data supported the significant increase in students' scores and the nonsignificant difference when e-book utilization was compared to the blended learning modality. The only challenge that the students experienced during the utilization of e-books was the difficulty in installing the e-books when phones are nearly full.

RECOMMENDATION

1. The use of interactive e-books can be employed as an alternative learning strategy for the Science 9 subject in times when teaching and learning are distant. Thus, more teachers should be trained in designing, producing, and employing e-books in the teaching-learning process due to its great benefits and achievable results in terms of academic performance.
2. This study only measured the impact of interactive e-books in enhancing the mastery level of students on selected competencies in science 9. Other aspects such as attitudes towards science and other attributes were not measured, therefore, could be a great potential for future investigations. The developed e-books that were used could also be used for further research but in another set of participants.
3. Studies utilizing both e-books and the use of two-way radios could be conducted to see if the combination of the two modalities could attain a 90% and above mean percentage score (MPS).

ACKNOWLEDGEMENT

The researcher would like to thank the Policy and Planning Research Division of DepEd – Region 2 for the funding of this study and the respondents for their active participation.

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