Remittances Review

April 2024,

Volume: 9, No: 2, pp.941-955

ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received : 05 February 2024, Accepted: 10 March 2024

DOI: https://doi.org/10.33282/rr.vx9i2.53

The Effects of Digital Textbooks on Students' Academic Achievement: An Experiment on Elementary School Students

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Abstract

The world is developing economically, technologically, and educationally, and there is a lot of revolution in the field of education. In earlier times, people used to write on leather and tree bark; they used to carve stone and write, but soon it was replaced by paper. Now, the use of paper should be stopped; firstly, the process of making paper is very expensive. Secondly, it is heavy and difficult for children to carry, and it also creates environmental pollution; this paper is wasted sustainable. Not fit to be. Solving all these problems, these paper books have now been

replaced by digital textbooks. This was experimental research; two groups of 30 students of 7th grade of Al-Rafiq Public Elementary School were formed; one group was taught by books in hard form, and the experimental group was taught in soft form by PDF books, videos, AI, and through WhatsApp group. The summative achievement test was taken from both groups as a post-test, and the marks of children educated with digital books were significantly higher. The performance of students who learned through digital books was much better in the Speed test, like MCQ-type tests, but slightly slower in the Power tests, like essay-type questions. Children who wrote on paper completed the Power test within the specified time limit, but this problem could be improved by computer keyboard typing practice. No effect was observed on children's hearing and vision in hard form. Children with textbooks have been diagnosed with the common problem of colour blindness. It is recommended that digital textbooks be promoted at the government level. Every school should have a library of tablets; teachers should also be given special training.

Keywords: Books, Digital textbooks, PDF, AV-Aids, Academic achievements.

Introduction

An age of more efficient and effective sharing of knowledge and data has come with the advent of digital technology. Books have always played an important role in conventional media, and their digital adaptation has ensured that they continue to do so in the modern day. Numerous approaches to effectively incorporate digital technology into educational settings have been the subject of vigorous research in the field of education. Digital textbooks are a key concern in the process of digitizing education, especially as textbooks are the most important learning tools used in classrooms and other learning contexts (Lee et al., 2023; Im, 2024).

Digital textbooks have emerged as a means for students to shift their focus from the monotony of reading to the excitement of discovery, but there are advantages and disadvantages, according to schools that have used them. Possible gains for schools that switch to digital curricula, particularly those that ditch paper textbooks in favour of online resources. Having digital textbooks also improves a student's access to, engagement in, and capacity to tailor their educational experience. Students can alleviate some of the weight and stress associated with their bags by switching to digital devices like e-readers, which also help schools save money on printing costs (McHaney, 2023; Tafani, 2023).

There is a notion that is growing and changing all the time, and that is the digital textbook. When textbooks were first digitalized, it meant just converting printed volumes to electronic formats, such as e-books or static PDF files. They have progressed into digital textbooks that incorporate multimedia and interactive elements in response to different needs in the educational sector (Jang

& Shin, 2016; Kim & Kim, 2022). Notable features of digital textbooks include their portability, which allows them to be used anywhere, their capacity to evolve and adapt to meet the needs of users (ElAdl & Musawi, 2020), and their sustainability, which could lead to cost savings for both the economy and the environment (Al Mulhim & Zaky, 2023).

Since the beginning of digital textbooks, there has been much research on how they affect students' cognitive ability and academic accomplishment. Many studies have looked at the efficacy of digital textbooks from a cognitive standpoint, as improving students' cognitive abilities has long been considered an important aim of formal education. Students' cognitive abilities across a variety of disciplines have been found to improve when digital textbooks are used (Lim et al., 2022; Wijaya et al., 2022).

There has been a dearth of discussion on the effects of digital textbooks on domains outside of cognition, such as emotional and social dimensions, which are more important in today's education. Although the benefits of digital textbooks are widely acknowledged, many still have reservations about their limits. It is yet unclear if digital textbooks are more effective than printed ones (Al-Qatawneh et al., 2022); furthermore, some research has shown that students do not favour digital textbooks (Johnston et al., 2015).

Consequently, it is crucial to make judgments cautiously by assessing the cost-effectiveness ratio when contemplating the implementation of digital textbooks on a broad or national scale. Policies should be implemented gradually to ensure widespread coverage, and decisions should be based on data from long-term longitudinal research. While several research has methodically investigated the efficacy of digital textbooks, few have conducted long-term longitudinal studies, according to surveys of the existing literature on the topic (Lim et al., 2022; Ryu & Byun, 2012).

Statement of Problem

The world is developing a lot economically, technologically, and educationally, and there is a lot of revolution in the field of education. In earlier times, people used to write on leather and tree bark; they used to write by carving stones, but it was soon replaced by paper. Now the use of paper should be stopped; firstly, the process of making paper is very expensive; secondly, it is heavy and difficult for children to carry, then it also creates environmental pollution, this paper becomes waste, it is not suitable for sustainable development at all. To solve all these problems, digital textbooks have now replaced paper books. People love the books in PDF, AI-assisted, and easy-to-learn YouTube productions. The paper needs heavy machinery for preparing, printing, ink, and stocking boxes, then selling and purchasing can all be easily read by downloading the books in soft form to tablets or phones to get rid of the problem. Carry digital gadgets in your pocket everywhere, with no lighting problems and no load-shedding problems. Digital books can

also be read easily at night without sufficient lighting in the room while waking up, drinking tea, listening to videos, and listening to online lectures while driving. Even the test can be given online, saving time, getting rid of huge school buildings, getting rid of classrooms, getting rid of pick and drop, getting rid of health problems, getting rid of natural calamities, getting rid of disaster risk, getting rid of traffic, getting rid of petrol, fumes, and noise of the vehicles which happen while delivering the children to school. Saving time for parents, getting rid of children's fights in the school environment, getting rid of harassment cases, and many more facilities are available. The purpose of this research work was to shed light on all the issues and solve them with digital textbooks, as well as to diagnose the pros and cons with an experiment.

Objectives of the Study

The following were the objectives of the study;

1. To check the effects of Digital Textbooks on students' academic achievement.
2. To check the effects of Digital Textbooks on students' health.
3. To investigate the pros and cons of Digital Textbooks.
4. To give suitable suggestions about Digital Textbooks.

Hypothesis of the Study

The following were the hypotheses of the study;

Ho.1 Digital Textbooks have no effect on students' academic achievement.

Ho.2 Digital Textbooks have negative effects on students' health.

Significance of the Study

Research on digital books will not only be very useful for students but will bring a revolution in the education field. Digital books will revolutionize Pakistan's economy because they will play an important role in eliminating paper production, printing costs, ink production, stocking, loading and unloading costs, waste losses, bulk load, and saving time. This research will be useful for stakeholders, parents, and educational policymakers alike. This research will provide a foundation for future researchers.

Literature Review

The notion of digital textbooks should be seen as one that is always changing (Turel & Sanal, 2018). Moving from a printed to a digital format, they started off as basic e-books, similar to PDF files. However, modern digital textbooks with a wide range of features emerged as they

were implemented in classrooms and adapted to meet the demands of students. Features like bookmarks, notes, highlights, hyperlinks, and access to other learning resources have been incorporated into digital textbooks in recent years to facilitate user interaction with the material. In fact, they have progressed to the point that they can function as interactive, collaborative online textbooks (Lim et al., 2022; Im, 2024).

Digital textbooks are divided into two generations, according to Jang and Shin (2016). This categorization states that first-generation digital textbooks, commonly called PDF-based textbooks or basic electronic textbooks, are simply digital copies of current textbooks with little to no interaction. In contrast, a new kind of textbook called a second-generation digital textbook has interactive features and covers more ground than traditional printed textbooks. Collaborative digital textbooks, cyberbooks, I-textbooks, or hybrid textbooks are some names for them.

Digital textbooks include a number of qualities. All the digital information from previous textbooks is there, plus a plethora of user-friendly features, multimedia capabilities, and communication tools. Some user-friendly features include the ability to annotate or highlight certain passages. In addition, according to Rodríguez-Regueira and Rodríguez-Rodríguez (2022), they make it possible for users to seek meanings of words, conduct searches for more information, and participate in detailed studies by means of hyperlinks. Digital textbooks have multimedia functions that traditional textbooks do not, like photographs, movies, 360◦/3D images or films, and audio elements. According to ElAdl and Musawi (2020), these textbooks are also accessible to students with visual impairments since they include recorded audio elements and Text-to-Speech (TTS) features. The use of augmented and virtual reality in online textbooks has just been reported (Lim et al., 2022). The term "communication functions" describes a set of capabilities that enable users to communicate and collaborate in an online setting, whether that's through publishing and commenting on conversations or through real-time messaging. The ability to upload and get comments on assignments makes it much easier for students to finish and turn in their work (UNESCO, 2017).

Until 2007, the phrase "electronic textbook" was used in Korea. However, in 2007, the word "digital textbook" was first used by the Korea Education and Research Information Service. Since then, the country's policies have been geared towards digitizing textbooks. Digital textbooks were described by Byun et al. as "digital learning materials that digitize existing printed textbooks, incorporating the advantages of printed books along with additional convenience features such as search and navigation, as well as multimedia learning functions like animation and 3D, to maximize convenience and learning effectiveness." So far, this definition has seen a lot of use.

Digital textbooks with cutting-edge AI technologies have recently been the focus of integration attempts. Artificial intelligence (AI) may help students learn on their own by answering questions as they go along, tailoring challenges to each student's current skill level, and so on.

This gives students the freedom to explore topics at their own pace and gauge their progress. A huge step forward in interactive and personalized learning might be achieved by incorporating AI into online textbooks. After a two-year development and preparation period beginning in 2023, South Korea will officially use AI digital textbooks for third and fourth graders in elementary school, first and second graders in middle school, and third and fourth graders in high school by 2027. The textbooks will focus on mathematics, English, and information science (Im, 2024).

In order to ensure that present and future generations have access to quality education, a sustainable education system must be environmentally, economically, and socially sound. Because of their central role in the educational process, textbooks and other instructional media must be developed and selected with a focus on long-term sustainability. This is one area where digital textbooks really shine.

In their 2023 assessment, Al Mulhim and Zaky highlighted the environmental benefits of electronic textbooks over paper textbooks and discussed the many ways in which digital textbooks contribute to sustainability. In particular, it highlighted the possible financial savings from utilizing e-books and the advantages of preserving resources and lowering classroom energy use.

From a social sustainability standpoint, digital textbooks also have their benefits. In a nutshell, digital textbooks have the potential to raise students' sustainability consciousness (Valverde-Berrocoso et al., 2020). According to Kim and Kim (2022), digital textbooks can offer equal educational chances for students who are visually impaired since recorded voices can be used in e-books.

The use of electronic textbooks has been shown in several studies to improve students' analytical and reasoning skills (Yu & Kim, 2015). Evidence suggests that students' cognitive competencies, including their capacity for self-directed learning and problem-solving, and their academic performance in core areas like science, English, and mathematics, can be improved by the usage of digital textbooks (Cha et al., 2017). Digital textbooks provide advantages over printed ones, according to Metcalf et al. 2023. These advantages include self-testing, highlighting, and generative techniques.

The efficacy of online textbooks, nevertheless, remains debatable, according to some (Gronlund et al., 2018). While student preferences may not significantly influence real usage decisions, digital textbooks may fall short of students' expectations, as pointed out by Johnston et al. (2015) in their study comparing digital and paper textbooks. Research on student preferences for digital textbooks has yielded mixed findings. Therefore, further study is needed to determine if these preferences influence the likelihood of sustained usage or the efficacy of use. According to Gronlund et al. (2018), instructors' ignorance and incompetence with IT might be limiting the use and efficacy of digital textbooks. Contrarily, digital textbooks have a high level of use, according

to a study of college students conducted by Al-Qatawneh et al. (2019), but their efficacy has not been adequately demonstrated to warrant their widespread adoption. Research on digital textbooks varies in methodology, intended audience, and length of time spent using the resources, which is to be expected. So, to get broad and universal implications for Pakistani schools, an experimental study is needed.

In contrast to cognitive skills, affective competencies are concerned with the emotional domain and encompass traits like character, beliefs, and values, as well as interest, drive, and perceptions of one's own capacity for learning. Student attributes, self-concept, motivation, and willingness to learn are the four sub-domains that makeup students' attitudes towards learning in the worldwide comparative research TIMSS (Mullis & Martin, 2015). A student's emotional competencies, including their belief in their own abilities to study, their enthusiasm for learning on an intrinsic level, and their attitude towards learning, are critical for academic success (Sritharan, 2018).

A person's self-efficacy may be defined as their belief in their own abilities to plan and carry out the steps that will lead to a desired result. It's well-established that self-efficacy plays a major role in determining academic success. Higher levels of cognitive and meta-cognitive techniques, as well as the ability to persist in the face of adversity, are associated with greater academic success for students who report high levels of self-efficacy. The importance of self-efficacy cannot be overstated in today's increasingly digitalized classrooms. According to Chen and Su (2019), e-books integrated with a learning management system enhance students' self-confidence and capacity for independent study. Similarly, ElAdl and Musawi (2020) found that student's willingness to study and self-efficacy are both positively impacted by using e-books.

The two most important emotional factors influencing students' performance are their intrinsic drive to learn and their attitude toward learning. The motive to study is a strong predictor of academic performance; research has shown that students do better in school and retain more information when their motivation levels are high (Sritharan, 2018). A significant problem with online classrooms is maintaining students' interest and motivation throughout the learning process. Hence, a lot of studies have looked at what makes people more motivated to learn and how to make that happen (O'Bannon et al., 2017).

According to Sun and Pan (2021), students' willingness to study and their ability to learn independently may both be improved by the use of e-books that are connected with information technology in the classroom. Students who used interactive iBooks reported feeling more invested in and motivated to learn. Students' motivation to learn is enhanced by e-books with many features, according to Turel and Sanal (2018), when contrasted with static, plain PDF textbooks.

The effect of electronic books on students' emotional abilities has been the subject of a great deal of research in the academic world. Whereas textbooks play a more central role in elementary, middle, and high school classrooms, less is known about how digital textbooks enhance students' emotional abilities in these settings. According to ElAdl and Musawi (2020), electronic books increased the motivation to learn among college students; however, this was not the case in elementary school.

Digital textbooks, as opposed to plain old e-books, are thought to improve students' social abilities because of all the interactive aspects they provide. According to Saini and Kaur (2019), digital textbooks allow for two-way contact between instructors and students, along with interaction between students and the e-book, which might lead to better learning outcomes. In addition, according to Van van Oudeweetering and Voogt (2018), these elements have the potential to improve students' social competencies by encouraging them to communicate and work together. Students were more likely to communicate with one another when using e-books, according to Metcalf et al. (2023). UNESCO (2017) conducted a qualitative study with educators and found that digital technology is helpful for facilitating communication and cooperation in the classroom. According to Sun and Pan (2021), e-book features improve student-teacher interactions, which in turn improves learning techniques and academic achievement.

The geographical restrictions of digital learning settings and the constraints of media mediating interactions might make it hard to achieve social competencies, according to certain criticisms (Kreijns et al., 2023). Environmental restrictions hinder proper interpersonal interactions, especially in online education situations, despite instructors' and students' knowledge of and efforts toward social competencies (Muuro et al., 2014). Research on the effects of digital textbooks on social competencies is required in these settings because of the increased emphasis on digital textbooks' interaction characteristics.

With the help of the British Educational Suppliers Association (BESA), the UK launched LendED in 2018 as an open platform for education technology (Im, 2024). Schools can use this portal to find and buy digital resources for instruction. In 2000, Singapore began testing out digital textbooks for first-year secondary school pupils; in 2002, Malaysia followed suit. With the aim of developing digital infrastructure countrywide by 2024, Germany initiated the Digital Schule initiative in 2019 (Greifenberg, 2020). The National Educational Technology Plan is an initiative of the US federal government that aims to reduce digital education inequalities by guiding the use of technology in American classrooms (Escueta et al., 2017). Beginning in 2020 and continuing until 2023, the "GIGA school project" in Japan will promote digital infrastructure and facilitate the country's shift to digital education via e-learning platforms (Lander, 2022). With the introduction of the "e-schoolbag" and the free distribution of digital textbooks to schools in 2018, Estonia has quickly become a leading light in the European Union's education system (Estonia, 2022).

Research Method

It was experimental research; in this research study, the effect of digital textbooks on students' achievement was seen, and its effects on students' health were also evaluated, such as any effects on the ears while listening to audio or any effects on the eyes, etc. This research was conducted on the seventh-class students of Al-Rafiq Public Elementary School. For this purpose, the 7th class Iqbal group was selected for research. Then, the children were given a pre-test, which was an achievement test. There was a total of 42 students in the class. High achievers and low achievers were excluded through pre-test results. Only 30 average scorers were selected for the research. Thirty students selected in the sample were divided into two groups by fishbowl random sampling. A control group consisting of fifteen students was formed, and another experimental group consisting of fifteen students was formed.

Experiment Procedure

The experimental group was taught through soft material like PDF books, and audio and video learning materials were uploaded to their cell phones. At the same time, the control group was taught through traditional printed textbooks in hard form. Experimental group learning materials were provided in software form, with all books created as PDFs. Video lectures were recorded and put into cell phones, and they were also trained in AI. A WhatsApp group was also created, and students were given instant help. All education systems were brought to digital textbooks, and students were free from the burden of Basta Load; they were now studying only through cell phones or tablets.

Treatment

Children were taught through soft form books, all books were converted to PDF, some more good notes were also composed and made into PDFs of the screen, some video lectures were also made, and they were also given to the children on their cell phones. From time to time, more improvements were made to them. Audio messages were also shared in the WhatsApp group, and a discussion session was also held in the WhatsApp group. Special training was also conducted for children to read from cell phones, how far to read from the eyes, and how much to keep the voice. Apart from this, the method of answering questions through AI was also explained. In the beginning, the children faced some difficulties, but they learned quickly. It was also ensured that the children did not misuse the cell phone except for educational material only.

Medical Test

Before starting this experimental research, the help of BHU Hospital doctors was taken. They were invited to a feast at the school, and a medical file was created for each child after hearing

and visual examination of the children of both the control and experimental groups. A record of children's hearing limits, visual impairment, and colour blindness was compiled.

Experiment Duration and Formative Assessments

This research continued for one year. Educational sessions were taught in soft form to the children. During teaching, formative tests are also taken from the children, just like the rest of the students are taken in the normal routine. Apart from this, some software was also uploaded to the children's cell phones to improve their writing speed. Apart from this, midterms, etc., were also taken from children on cell phones, for which Google forms were created and MS spreadsheets were used.

Development of Tools

For this research, two major tests were developed. A pre-test was conducted to sample average scorer children. Second, a comprehensive achievement test with a common routine was taken, which is usually taken by the students of class $7^{th;}$ it is called a summative test. For the experimental group, these tests were put in their cell phone in PDF form, and for the control group, these tests were printed and given to them in hard form.

Validity and Reliability of the Tools

Validity was assessed only for the pre-test; since the post-test was the same for the entire school, reliability was also assessed for the pre-test only. Pre-test reliability was 0.923, which was excellent.

Data Analysis Procedure

The data was analyzed in two ways: first, the progress of both groups was checked by taking general achievement tests, and then the experimental group's power test and speed test were checked. Both these were checked through cell phones. For the speed test, Google Forms and the Power test spreadsheet were used. Both tests were taken on paper from the control group. Google form MCQs were printed for the speed test, and the questions for the power test were also printed and given to the control group in hard form. Both groups were given the same time limit.

Results of the Study

The children's post-test was an achievement test, which consisted of 500 marks. This test continued for five days, and every day, a paper with 100 marks was taken. It had two parts: one

part was the speed test, which included MCQs, and the other part was the power test, which had short questions and long questions.

Table 1

Ho1. Digital Textbooks have no effect on students' academic achievement.

Independent Sample t-test					
Groups	*f*	μ	σ	t	α
Experimental	15	322.87	2.200	-159.111	.000
Controlled	15	441.87	1.885		

Table 1 describes the achievements of both groups of students. It was found that the experimental group's mean was surprisingly higher than the control groups, and a significant difference was found between both group's mean scores. The mean value of the control group was (322.87), and the standard deviation was (2.200). The mean value of the experimental group was (441.87), and the standard deviation was (1.885). The t-test value was (-159.111), $p < .05$; the null hypothesis was not accepted.

Ho2. Digital Textbooks have negative effects on students' health

Before starting this experimental research, the help of BHU Hospital doctors was taken. They were invited to a feast at the school, and a medical file was created for each child after hearing and visual examination of the children in the experimental group. A record of children's hearing limits, visual impairment, and colour blindness was compiled. After the experiment was completed, the doctors were invited again, and the children's medical check-up was done; no one found any effect on the children's hearing, and the children's vision was also better. They were also re-tested, and after the test, it was found that they also had a slight problem of colour blindness, and this problem was slightly more than the experimental group. That is, it was concluded that looking at the black and coloured words of books in hard form makes colourblindness a problem because digital books also have audio, so children have to look at the material for a very short time.

Research Conclusions

It was concluded that students learning from digital textbooks was very good because it was also a new technological pedagogical technique. It not only taught children in soft form but also worked as an audio-visual aid. AI itself acts as a teacher to enhance children's learning.

The burden of education on the economy will be reduced by 90%, and the budget for paper, printing, stocking, loading, etc., can be saved every year.

The basta load was absolutely zero, and the children were more attracted to something new. Nowadays, using cell phones has become a part of children's routine, and children cannot stay away from cell phones, so it would be better to make the same cell phone a source of their education.

Children's writing speed was found to be low, which can be improved by computer keyboard practice. The children's speed test was found to be very good because the MCQs on touch cell phones only need to be touched, in contrast to solving questions on paper, which requires a pen, which is quite difficult.

There was no such side effect diagnosis on the children's hearing and vision that could be noted, but those who read the book in hard form had mild colour blindness; some children may get contact lenses in the future.

Recommendations

According to the study conclusion, recommendations were made as follows;

1. It is recommended that digital textbooks should be promoted at the government level, tablets should be provided to children to save on printing costs, and a library of tablets should be created in every school.
2. Teachers should be given special training on digital test books.
3. A government-level organization should be created for soft media to publish digital textbooks.
4. Typing should be promoted through a computer keyboard.

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