An Experimental Study on the Impact of Digital Textbooks on the Academic Achievement of Elementary School Students

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Received on: 09-01-2024 Accepted on: 15-02-2024

Abstract

Education is undergoing a period of revolutionary change as the globe experiences economic, technical, and educational development. Before paper came around, people would carve designs into stone or write on leather or tree bark. The production of paper is an extremely costly operation, hence we must cease using it immediately. Second, it's not sustainable because it's heavy for kids to handle and because it pollutes the environment. Unfit for the role. These paper books are now obsolete because digital textbooks have solved all these problems. Thirty-seventh graders from Al-Rafiq Public Elementary School participated in the study as subjects. Half of the students in the control group received their education through traditional textbooks, while the other half received their instruction in a more modern, digital format using tools like artificial intelligence (AI), video lectures, and a WhatsApp group. Children who were taught using digital books had considerably better scores on the summative achievement exam, which was administered to both groups as a post-test. Students who studied from electronic books performed marginally better on Power tests (which include essay questions) but substantially better on Speed tests (which include multiple-choice questions). Students who were given the Power test to complete on paper managed to do so within the allotted time; however, this may be remedied with some practice on a computer keyboard. The hard shape has no discernible impact on children's eyesight or hearing. The prevalent condition of color blindness has been diagnosed in children with textbooks. Digital textbooks should be supported by the government. Along with providing teachers with specialized training, every school should provide students with access to a library of tablets.

Keywords: Digital textbooks, Soft books, PDF.

Background of the Study

With the rise of digital technology, we have entered a new era of faster, more accurate information sharing. Books have long been staples of traditional media, and their digital transformation has only served to cement this position in the present day. Extensive study in the field of education has focused on various techniques to successfully integrate digital technology into educational environments. Since textbooks are the most essential learning resource utilized in educational settings, digital versions of these volumes naturally provide a significant challenge to the digitization of education as a whole (Lee et al., 2023; Im, 2024). According to schools that have implemented digital textbooks, there are pros and cons. On one hand, they allow pupils to escape the boredom of reading and dive into the wonders of discovery. On the other hand, there are certain drawbacks. Potential benefits for schools that adopt digital curricula, especially those that make the transition from paper to digital textbooks. Students are more engaged, have more access, and may better personalize their educational experience with digital textbooks. Switching to digital devices like e-readers can help students reduce the weight and strain on their backpacks while also helping schools save money on printing costs (McHaney, 2023; Tafani, 2023).

The concept of the digital textbook is always evolving and expanding. The original digitalization of textbooks merely involved scanning and transferring physical books into electronic formats like e-books or static PDF files. Digital textbooks with multimedia and interactive features have evolved to meet various demands in the education sector (Jang & Shin, 2016; Kim & Kim, 2022). Digital textbooks have several appealing qualities, such as being accessible from any location, being able to change and adapt to the demands of users (ElAdl & Musawi, 2020), and perhaps being more sustainable, which might result in financial and ecological benefits (Al Mulhim & Zaky, 2023).

Much study has been conducted on the effects of digital textbooks on students' cognitive abilities and academic success since their inception. Since enhancing students' cognitive capacities has long been recognized as a significant goal of formal education, numerous research have examined the effectiveness of digital textbooks from a cognitive perspective. Researchers have discovered that using digital textbooks improves students' cognitive ability across multiple disciplines (Lim et al., 2022; Wijaya et al., 2022).

The impact of digital textbooks on non-cognitive areas, such as the increasingly crucial emotional and social aspects of modern education, has received surprisingly little attention. The advantages of online textbooks are well-known, but many people are skeptical about their limitations. Digital textbooks may or may not be more effective than printed ones; moreover, pupils may not prefer digital textbooks, according to certain research (Al-Qatawneh et al., 2022). (Johnston et al., 2015).

So, when thinking about digital textbooks on a large or national scale, it's important to be careful and weigh the costs and benefits. Decisions should be grounded in evidence from long-term longitudinal studies, and policies should be implemented gradually to guarantee widespread coverage. A review of the relevant literature reveals that while many studies have looked at the effectiveness of online textbooks, very few have used a longitudinal design to track students over time (Lim et al., 2022; Ryu & Byun, 2012).

Justification of the Study

There has been a great deal of change in the area of education, and the globe is experiencing tremendous economic, technological, and educational development. Paper quickly supplanted earlier writing media such as leather and tree bark, as well as cutting stones. We need to put an end to using paper immediately for several reasons: first, it's expensive to make paper; second, it's heavy and tough for kids to carry; third, it pollutes the environment; and finally, it's unfit for sustainable development because it ends up in landfills. Digital textbooks have mostly supplanted paper books as a solution to these issues. Books in PDF, with the help of AI, and YouTube videos that are easy to understand are quite popular. Downloading books in digital form to tablets or phones eliminates the need for heavy machinery for paper preparation, printing, ink, and stocking boxes. This simplifies buying and selling. With no need to worry about power outages or inadequate illumination, you can take your digital devices with you anywhere. You can read a digital book as you sip your morning tea, watch a movie, or listen to an online lecture while driving—even if there isn't enough light in the room. It is possible to administer the test online as well, which would eliminate the need for large buildings and classrooms, as well as many other time-consuming and potentially hazardous school-related issues, such as traffic, pollution, and the dangers posed by natural disasters and other man-made hazards. A plethora of services are at parents' disposal, including the elimination of harassment cases, the reduction of student conflicts in the classroom, and much more. This study set out to answer all of those questions—how can digital textbooks help, and what are the benefits and drawbacks?—by experimenting.

Primary Research Goals

The study aimed to achieve the following objectives:

1. This study aims to evaluate the impact of digital textbooks on students' performance in the classroom.
2. We need to see how digital textbooks affect kids' well-being.
3. Examine the benefits and drawbacks of online textbooks.
4. To make appropriate recommendations regarding Online Textbooks.

Examined Hypothesis

The research was based on the following hypotheses:

1. Students' performance in the classroom is unaffected by the use of digital textbooks (Ho.1).
2. Students' health is negatively impacted by digital textbooks (Ho. 2).

Importance of Research

Studying electronic texts will not only benefit students greatly but will also completely transform the way we teach. By reducing or eliminating the need for paper, printing, ink, stocking, loading, and unloading, as well as waste, bulk loading, and wasted time, digital books will have a profound impact on Pakistan's economy. Educational policymakers, parents, and stakeholders will all benefit from this study. Future scholars will be able to build upon these findings.

A Survey of the Literature

The idea of online textbooks is constantly evolving (Turel & Sanal, 2018). They began as simple e-books, comparable to PDF files when they transitioned from print to digital. Nevertheless, as digital textbooks were used in classrooms and modified to suit students' needs, more advanced versions with numerous capabilities came into being. Digital textbooks have recently included features that allow users to interact with the material more easily. These features include bookmarks, notes, highlights, hyperlinks, and access to other learning resources. They've come a long way and can now serve as online textbooks that students can work together on (Lim et al., 2022; Im, 2024).

Jang and Shin classify digital textbooks into two distinct generations (2016). In this classification, first-generation digital textbooks—also known as PDF-based textbooks or basic electronic textbooks—are static digital replicas of existing textbooks. On the other hand, second-generation digital textbooks go beyond the scope of conventional printed textbooks by including interactive features and covering more material. They are also known as hybrid textbooks, collaborative digital textbooks, cyberbooks, or I-textbooks.

Several features are included in digital textbooks. There is a wealth of user-friendly features, multimedia capabilities, and communication tools in addition to all the digital information from earlier textbooks. The option to highlight or annotate specific paragraphs is one user-friendly feature. Also, as per Rodríguez-Regueira and Rodríguez-Rodríguez (2022), they enable users to look up definitions of words, search for additional material, and take part in in-depth studies through hyperlinks. Multimedia features such as audio components, 360◦/3D images or films, photographs, and videos are available in digital textbooks but are not in traditional textbooks. Students with visual impairments can also access these textbooks through the use of recorded audio elements and Text-to-Speech (TTS) functionalities, according to ElAdl and Musawi (2020). A recent paper mentioned the integration of AR and VR into online textbooks (Lim et al., 2022). "Communication functions" refer to a collection of features that let people work together in an online environment, whether it's through instant messaging, publishing and commenting on discussions, or something else entirely. Students find it much easier to complete and submit homework when they can upload them and receive comments on them (UNESCO, 2017).

The term "electronic textbook" was in use in Korea up until 2007. On the other hand, the Korea Education and Research Information Service coined the term "digital textbook" in 2007. The government's policies have since prioritized the digitization of textbooks. Through their research, Byun et al. defined digital textbooks 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." There has been a lot of usage of this definition thus far.

Recent efforts at integration have focused on digital textbooks with state-of-the-art AI technologies. With the use of AI, students could be able to study independently by completing tasks based on their present ability level, receiving immediate feedback on their progress, and so on. Students can move through the material at their speed and see how far they've come because of this. Online textbooks that use AI might be a game-changer for interactive and personalized learning. South Korean students in grades three and four will formally use

artificial intelligence (AI) digital textbooks by 2027, following a two-year development and preparation period starting in 2023. Students in grades one and two of middle school, and students in grades three and four of high school will also use these textbooks. Subjects covered in the textbooks will include information science, English, and mathematics (Im, 2024).

A sustainable education system looks out for the environment, the economy, and society to make sure that everyone can get a good education, now and in the future. Textbooks and other forms of instructional media are crucial to the educational process, thus it's important to think about their longevity while making decisions. Here is where online textbooks truly excel.

In their evaluation for 2023, Al Mulhim and Zaky emphasized the several ways in which digital textbooks contribute to sustainability, highlighting the environmental advantages over paper textbooks. In particular, it brought attention to the potential cost savings from using e-books, as well as the benefits of resource preservation and reduced energy consumption in the classroom.

There are societal sustainability benefits to using digital textbooks as well. To sum up, online textbooks may make students more aware of the importance of environmental protection (Valverde-Berrocoso et al., 2020). Because e-books can incorporate recorded voices, digital textbooks can provide visually challenged students with similar educational opportunities (Kim and Kim, 2022).

Multiple studies have demonstrated that students' analytical and reasoning abilities are enhanced when they utilize electronic textbooks (Yu & Kim, 2015). Utilization of digital textbooks has been found to enhance students' cognitive abilities, such as their ability to learn independently and solve problems, as well as their academic achievement in fundamental subjects such as science, English, and mathematics (Cha et al., 2017). Metcalf et al. 2023 states that there are benefits to using digital textbooks instead of printed ones. Benefits such as generative approaches, self-testing, and highlighting are included in this.

But, as some have pointed out, the effectiveness of online textbooks is still up for debate (Gronlund et al., 2018). Johnston et al. (2015) noted in their study comparing digital and paper textbooks that students' expectations may be unmet by digital textbooks, even though student preferences may not greatly impact real usage decisions. There has been conflicting research on student preferences regarding digital textbooks. Hence, more research is required to ascertain whether these preferences impact the possibility of continued use or the effectiveness of use. Gronlund et al. (2018) suggest that teachers' lack of knowledge and skill in information technology could be preventing digital textbooks from being fully utilized and effective. On the other hand, digital textbooks are widely used by college students (Al-Qatawneh et al., 2019), but there isn't enough evidence of their effectiveness to justify their broad use. Naturally, there is a wide range of approaches, target populations, and durations of use among studies examining digital textbooks. Thus, a controlled experiment is required to draw generalizable conclusions for educational institutions in Pakistan.

Affective competencies, in contrast to cognitive skills, are more concerned with the emotional domain and include things like character, beliefs, values, interests, motivation, and ideas about one's learning potential, among other things. In the global comparative research TIMSS, students' attitudes towards learning are comprised of four sub-domains: student qualities,

self-concept, motivation, and readiness to learn (Mullis & Martin, 2015). Academic achievement is highly dependent on a student's emotional competencies, which encompass their self-confidence in their study skills, intrinsic motivation to learn, and outlook on the learning process (Sritharan, 2018).

The confidence an individual has in their capacity to devise a strategy and see it through to completion is known as self-efficacy. The importance of self-efficacy in deciding academic performance has long been recognized. Students who believe in their abilities tend to be more resilient and smart, and they are also more likely to use cognitive and meta-cognitive strategies to succeed in school. It is crucial to have self-confidence in today's increasingly digitalized schools. Electronic books that are part of a learning management system boost students' confidence and ability to study on their own, say Chen and Su (2019). In a similar vein, ElAdl and Musawi (2020) discovered that e-books have a favorable effect on students' self-efficacy and their desire to learn.

Students' attitudes toward learning and their innate motivation to study are the two most influential emotional aspects affecting their performance. Research has demonstrated that students do better academically and retain more knowledge when their levels of motivation are high, making the desire to study a powerful predictor of academic performance (Sritharan, 2018). Preserving students' engagement and enthusiasm for studying is a major challenge in online classes. The question of how to increase people's intrinsic motivation to learn has thus been the subject of much research (Ahmad et al., 2023; O'Bannon et al., 2017). Sun and Pan (2021) state that incorporating e-books into the classroom through information technology has the potential to increase students' motivation to study and their capacity for independent learning. There was a marked improvement in students' engagement and motivation to study after using interactive iBooks. Turel and Sanal (2018) found that compared to static, simple PDF textbooks, e-books with multiple features increased students' motivation to learn.

Academics have poured a lot of time and energy into studying how electronic books affect students' emotional abilities. In elementary, middle, and high school classrooms, textbooks are more prominent, but little is known about how digital textbooks improve students' emotional capacities in these types of classrooms. While electronic books did boost motivation to learn among college students, ElAdl and Musawi (2020) found no such effect in primary school kids.

Students' social skills may be enhanced by using digital textbooks, as compared to traditional e-books, due to the numerous interactive features they offer. Digital textbooks say Saini and Kaur (2019), facilitate two-way communication between teachers and students, as well as e-book interactivity, which could result in improved learning outcomes. Furthermore, these features may enhance students' social competencies by fostering communication and collaboration (Van van Oudeweetering and Voogt, 2018). Metcalf et al. found that when students used e-books, they were more inclined to talk to each other (2023). Digital technology is useful for promoting classroom cooperation and communication, according to a qualitative study with educators carried out by UNESCO (2017). Sun and Pan (2021) state that due to the enhanced student-teacher interactions made possible by e-book features, both learning approaches and academic accomplishment are enhanced.

Some have argued that it may be difficult to develop social competencies in online courses

due to the geographical limitations of these environments and the limitations of media-mediated interactions (Amir et al., 2022; Kreijns et al., 2023). Even while both teachers and students are aware of the importance of social competencies and make an attempt to practice them, environmental constraints make it difficult to have appropriate interpersonal interactions, particularly in online learning environments (Hussain et al., 2023; 2024; Muuro et al., 2014). The growing focus on the interactive features of digital textbooks necessitates studies examining their impact on students' social competence in these contexts.

The UK's LendED, an open platform for education technology, was launched in 2018 with the assistance of BESA, the British Educational Suppliers Association (Im, 2024; Umar et al., 2023). Through this platform, educational institutions can discover and purchase digital pedagogical tools. Both Singapore and Malaysia started experimenting with online textbooks for first-year high school students in the year 2000. Germany launched the Digital Schule programme in 2019 to create a nationwide digital infrastructure by 2024 (Hafeez et al., 2023; Hussain, 2021; Greifenberg, 2020). To help level the playing field in American schools when it comes to technology, the federal government has launched the National Educational Technology Plan (Zaman et al., 2023; Muhammad et al., 2023; Asad et al., 2023; Escueta et al., 2017). Starting in 2020 and running until 2023, the "GIGA school project" in Japan will support the country's digital infrastructure and help it transition to online education (Lander, 2022). Estonia has emerged as a frontrunner in the EU's education system since 2018 when it introduced the "e-schoolbag" and began providing schools with free digital textbooks (Hussain et al., 2022; Estonia, 2022).

Approach to Research

This study was experimental; its goals were to determine whether or not digital textbooks had any negative impact on student's academic performance and, by extension, their health in general, including whether or not they experienced any strain on their eyes or ears as a result of prolonged audio playback. Students in the seventh grade at Al-Rafiq Public Elementary School were the subjects of this study. This is why the seventh-grade Iqbal group was chosen for the study. After that, the kids were administered an achievement exam as a preliminary assessment. This particular class had forty-two pupils. Results from pre-tests were used to remove students who performed exceptionally well or poorly. The research only included 30 average scorers. The thirty students who were part of the sample were randomly split into two groups using a fishbowl method. Fifteen students served as a control group, while the same number of students served as an experimental group.

Setting Up the Experiment

The experimental group was instructed multimedia files sent to their mobile phones, including audio and video lessons and downloadable PDF books. Simultaneously, the control group received instruction through conventional, printed textbooks. All books were prepared as PDFs and experimental groups received their learning materials in software form. They were schooled in AI and given recorded video lessons to watch on their phones. Additionally, a WhatsApp group was set up where students could receive immediate assistance. Students no longer had to rely on Basta Load because all educational systems had transitioned to digital textbooks. They could now study anywhere, anytime using just their mobile devices.

Fed-up

All of the books were converted to PDFs, and the children were taught using soft-form books. They also received video lectures on their mobile phones, and their teachers made excellent notes and added them to the screen PDFs. Additional enhancements were made to them periodically. The WhatsApp group served as a platform for the exchange of audio messages and a forum for group discussion. Children also received specialized instruction on how to read on mobile devices, including proper eye-to-text distance and vocalization techniques. Along with this, the process of using AI to answer queries was also detailed. The kids had a rough go of it at first, but they picked it up fast. It was also made sure that the kids wouldn't use their phones for anything other than schoolwork. This experimental research was prefaced with consultations with medical professionals from BHU Hospital. They were extended an invitation to a school-hosted feast, and following a thorough physical and audiovisual evaluation of the youngsters in both the control and experimental groups, a medical record was prepared for each one. Information on children's visual impairments, color blindness, and hearing limits was recorded. For a whole calendar year, this study persisted. The lessons were gently presented to the kids. Like the rest of the pupils, the youngsters are also given formative assessments during the teaching process. Beyond this, we also installed software on the kids' mobile phones to help them write faster. On top of that, we utilized Google Forms and Microsoft Excel spreadsheets to collect midterms, etc., from students using their mobile devices.

Creation of Instruments

The researcher created two main tests for this study. Children with average scores were given a pre-test. The second step was to administer a summative test, which is a thorough accomplishment test that is typically given to seventh graders and follows a standard format. Those in the test group received the exams in hard copy form, while those in the control group received them in PDF format on their mobile devices.

Since the post-test was uniform across the entire school, reliability was likewise evaluated solely on the pre-test, and validity was limited to the pre-test. An outstanding pre-test reliability value of 0.923 was recorded.

First, we used general achievement exams to compare the two groups' improvement. Then, we looked at the experimental group's results on power and speed tests. Cell phones were used to verify both of these. The speed test was conducted using the Power test spreadsheet and Google Forms. Paper versions of both exams were administered to the control group. Both the speed test and the power test used printed multiple-choice questions. The control group received both sets of questions in hard copy form. The time limit was identical for the two groups.

Findings from the Research

The post-test that the kids took was an achievement test that was worth 500 points. There was a 100-point paper for each of the five days of this test. There were two sections to the test: a speed section with multiple-choice questions and a power section with both short and long answers.

Table 1
Student performance is unaffected by the use of digital textbooks (Ho1).

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		

The results of the two sets of pupils are detailed in Table 1. There was a statistically significant disparity between the means of the two groups, with the experimental group having a much higher mean than the control group. The control group had a mean value of (322.87) and a standard deviation of (2.200). The experimental group had a mean value of (441.87), with a standard deviation of (1.885). Since the t-test value was (-159.111) and the p-value was less than 05, the null hypothesis was rejected.

Ho2. Digital textbooks negatively impact the health of pupils.

The physicians at BHU Hospital were consulted before the commencement of this experimental study. Following a thorough evaluation of the experimental group's hearing and vision, they were invited to a school-sponsored feast and each child was assigned a unique medical file. We kept track of the children's visual impairments, color blindness, and hearing restrictions. The children's medical exams were conducted after the experiment ended, and the doctors were once again invited. No impact on the children's hearing was detected, and their vision was also found to be better. Additionally, they had a re-test, which revealed that similar to the experimental group, they exhibited a mild case of color blindness—albeit to a lesser extent. So, it was determined that colorblindness is an issue while reading books in hard copy form because digital books also have audio, so youngsters just need to look at the material for a very short period as it is.

Conclusions from the Research

Since it was a novel technology instructional approach, it followed that students benefited greatly from using digital textbooks. In addition to serving as an audiovisual aid, it provided children with gentle instruction. When it comes to helping kids learn, AI can take on the role of a teacher. Spending on paper, printing, stocking, loading, etc., can be cut annually, and the educational load on the economy will be lowered by 90%. There was zero Basta load, and the kids were more interested in trying something else. Because kids these days can't seem to get enough of their cell phones, it only makes sense to turn them into a teaching tool. Typing practice on a computer can help children whose writing speeds are low. Because multiple-choice questions on touch cell phones simply require a touch, rather than solving them on paper with a pen, which is fairly difficult, the children's speed test was determined to be quite good. Although no significant adverse effects on the children's eyesight or hearing were detected, some of the children who read the book on paper experienced slight colorblindness, and some of them may need corrective lenses in the future.

Recommendations

1. The study concluded with the following recommendations: the government should push digital textbooks; children should be given tablets to cut down on printing costs; and

every school should establish a library of tablets.

2. Special instruction on the use of digital test books should be provided to educators.
3. Soft media should form a government-level agency to publish online textbooks.
4. A computer keyboard should be used to encourage typing.

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