# The Impact of the Application of Digital Teaching Materials in the Classroom on Students' Learning Engagement

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Abstract: The inclusion of digital teaching materials within classroom teaching has become more common. The present essay targets identifying the core notion of digital learning materials, along with their defining features, and mentions the critical role these resources play in modern education. It conducts an in-depth exploration of the concept of learning engagement, discusses its significance in the educational milieu, and pays attention to various factors influencing learning engagement, including students' personal attributes, teacher-student interaction, instructional design, teaching environment, family, and social factors. Based on this, this paper will focus on the influence of digital teaching materials on students' learning engagement, investigate their potential benefits and challenges, and offer insights into the relationship between digital teaching materials and learning engagement. The research findings suggest that digital teaching materials can boost learning engagement and cultivating positive emotional experiences. Device misuse and equipment shortages must be addressed and suggestions are provided.

## 1 INTRODUCTION

Due to technological progress and wide-ranging online education, digital teaching materials (or textbooks) as an upcoming resource have become a huge part of all education programs. Textbooks as a factor of teaching and learning have evolved much over the past years. They have turned from being theoretically linear to more three-dimensional and vivid multi-sensory representations. The carriers of the former have graduated from printed texts to informatization and digitalization, and the functions have changed from single-directional reading to more contextualized and intelligent interactive teaching.

The topic of this paper will be a thorough examination and discussion of the impact of digital textbooks on the investment of students' learning. This article intends to analyze existing studies and variables that define this process to obtain a greater understanding of the advantages and difficulties of integrating digital teaching materials in traditional classroom instruction.

The aim of this investigation is to empower digital teaching materials to effectively support the educational process, rejuvenate students' motivation and creativity, and align with the goals of the times' development. By gaining a thorough understanding of the mechanisms through which digital materials influence learning engagement, it is conceivable that the potential advantages and obstacles of integrating digital textbooks in classrooms can be discerned. Additionally, this study aims to provide educators and policymakers with actionable insights and recommendations for enhancing the effectiveness of digital instructional materials, ultimately fostering increased student engagement in learning.

## 2 INTRODUCTION TO RESEARCH SUBJECTS

### 2.1 Digital Teaching Material

"Digital teaching material" encompasses educational resources that are available in digital format, designed for primary and secondary education students, systematically developed according to curriculum guidelines, and created using digital technologies. These materials are well-suited for teaching and learning activities within an information technology environment (Shan, 2023). It is important to note that there is currently no universally accepted definition for digital teaching material. Some researchers argue that digital textbooks serve as complements or



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substitutes for traditional printed textbooks and include a variety of multi-modal resources such as video content, audio files (like podcasts), educational software, interactive exercises, games, hyperlinks, QR codes, augmented reality animations, and learning platforms that facilitate teacher-student interactions (Moundy, K., Chafiq, N., & Talbi, M., 2021).

21st-century students, as Digital Natives, were born after the advent of digital technologies and grew up with them (Shan, 2023), and they are more inclined to learn through audio, video, and fragmented methods. Digital teaching materials that integrate various media are more conducive to students' awakening of consciousness and attention maintenance.

From the existing research, focusing on different disciplines, scholars have a wide discussion on the connotation and extension of digital textbooks, which shows that today's education circles attach great importance to this topic. Teachers of Chinese, mathematics, English, and other subjects that focus on indoor classrooms generally believe that the use of digital textbooks revitalizes textbook content, attracts learning interest, and thus improves students' participation in class (Li, 2022); The online education platform provides students with opportunities for communication and cooperation such as virtual experiments and interactive games, which enhances students' learning initiative and willingness (Huang, 2024).

Physical education, as a unique discipline, rarely has paper textbooks in the teaching process in the past. Therefore, the emergence of digital textbooks has brought advanced learning experiences to physical education classrooms. VR technology has been used to construct multiple perception systems and create immersive sports experiences for students in terms of vision, touch, stress point, etc., thus stimulating learning interest (Li & Su, 2023) and a love of the subject.

Research indicates that digital teaching materials have transcended the linear narrative and paper-based presentation formats. It has been commonly recognized that "the interactivity of multimedia computers is conducive to stimulating students' learning interest and their role as cognitive subjects" (He, 2002). After integrating technologies such as VR, big data, and artificial intelligence, teaching materials have further promoted their development towards contextualization and personalization, integrating the characteristics of different disciplines, achieving education through entertainment and individualized teaching, and creating a more open and diverse learning environment for students.

Since modern times, in the field of educational psychology, the Situated Cognition Theory has been widely accepted with regard to the issue of "How does learning occur?" "All learning is situational, that is, it takes place in a context with social and interpersonal characteristics and becomes an integral part of learning through interaction with learners (Illeris, 2014)." The knowledge students learn is abstracted from the life experience in a real situation, and only when they are placed in a specific situation can they integrate what they have learned and realize the development process of "contextualization - de-contextualization - re-contextualization". As a bridge between knowledge construction and life situations, digital textbooks improve the relevance of students and teaching content, thus attracting students' learning interest and promoting students' learning engagement at the emotional level.

In addition, education cannot "see the wood for the trees" (Dewey, 2005), and Salman Khan, one of the founders of the flipped classroom, attaches great importance to the connection between different knowledge concepts and regards it as the most effective way of education (Khan, 2015). For primary school children, the context of knowledge is usually distributed across units, cross-teaching materials, and even interdisciplinary. Digital teaching materials can provide conditions for multiple integration, make the teaching process more flexible, and make the process of students' acceptance of knowledge more smooth and convenient.

## 2.2 Learning Engagement

The concept of learning engagement was first proposed by scholar Schaufeli. It is regarded as a positive, complete, lasting, and healthy mental state related to learning (Schaufeli, 2002), and can be regarded as the sum of students' time and energy spent on learning activities. It is an important index that reflects the positive aspects of students' psychology and is closely related to students' learning performance and social adaptation.

It is commonly acknowledged that learning engagement can be divided into three dimensions: cognitive, behavioral, and emotional. Cognitive engagement refers to the cognitive strategies and learning methods adopted by students at the level of thinking activities. Behavioral engagement refers to specific behaviors such as class participation and homework completion; Emotional engagement refers to students' likes and dislikes of school, classmates,

teachers, etc., as well as their interest and attitude toward learning tasks. These dimensions can exist independently and influence each other at the same time (Zhang et al., 2021). Among them, some studies have pointed out that cognitive and emotional engagement are decisive factors for students' happiness and academic achievement (Pietarinen et al., 2014). Quantitative research on learning engagement is usually carried out from these three aspects, mostly using student self-report scales, and a small part combining teacher assessment and classroom observation (Huang, 2016).

## 3 THE INFLUENCING FACTORS OF LEARNING ENGAGEMENT

There are many factors affecting learning engagement, which can be divided into students' own factors, teachers' and instructional design factors, teaching environment factors, family and social factors, etc.

Using a nonlinear hierarchical model, Hu and Kuh (2002) analyzed self-reported data from 50,883 full-time undergraduate students from 123 institutions and found that the level of learning engagement was influenced by the interaction of students' personal characteristics and institutional characteristics. Men, white students, and students at public colleges were more likely to be "under-engaged" than women, African Americans, Latinos, American Indians, and students at private colleges. Students' socioeconomic status and academic preparation are positively correlated with learning engagement. Among these, the level of academic preparation comprises two key elements: first, the academic performance during high school, and second, students' expectations and aspirations for their future academic pursuits (for example, whether they intend to pursue postgraduate studies).

Hou (2011) utilized a comprehensive approach that combined surveys, classroom observations, and interviews to study teachers and students in two primary schools in Qingdao, China. The results indicated that students with superior academic performance were more likely to actively participate in class activities, receiving greater recognition and opportunities, which fostered a positive feedback loop. Favorable teacher-student relationships were found to enhance students' interest in learning and their willingness to participate. In contrast, students who exhibited signs of social withdrawal were more prone to experiencing classroom anxiety and fear, leading to reduced participation. The study also highlighted that experiential teaching methods were particularly effective in boosting student learning engagement. Interactive activities such as games and hands-on tasks were especially adept at stimulating students' enthusiasm for participation, whereas monotonous teaching methods and boring content tended to diminish their motivation. Furthermore, students with higher self-efficacy were more inclined to participate actively in class and expressed confidence in their ability to succeed. Conversely, the fear of making mistakes or failing acted as a barrier to classroom participation and diminished students' engagement in learning.

Furrer and Skinner (2003) pointed out the concept of "cumulative risk" in their research on children's learning engagement in primary school, referring to the number of missed connections between children and each of their parents, teachers, or peers. The study found that as the number of partners children lack contact with increases, their level of engagement in learning decreases significantly, especially in terms of behavioral and emotional engagement. This means that a lack of connection to any key social partner can lead to a child's negative performance in school, while a lack of connection to multiple partners can have an even greater negative impact. The study further revealed that the degree of influence exerted by different social partners on children's learning engagement varies. For example, a child's lack of contact with a teacher has the most significant impact on their engagement with learning, while a lack of contact with peers has a relatively small impact. Boys are more susceptible to cumulative risk than girls, which means boys need more support from parents, teachers, and peers to maintain positive learning attitudes and behaviors.

Sun (2011) investigated how three common interaction models—teacher-student interaction, teacher-class interaction, and group interaction—affect student participation in higher vocational English classrooms. Using a combination of questionnaire surveys, classroom observations, and audio recordings, the study found that the group interaction model demonstrated significant advantages in terms of the quantity, quality, manner, and frequency of student engagement. This model was also more effective in stimulating students' enthusiasm to participate. In contrast, while students showed a relatively higher willingness to engage in the teacher-class interaction model, their actual participation levels—in terms of both the duration and quality of their speaking—are somewhat limited. These limitations primarily stem from students'

English language proficiency and their accustomed receptive learning style. Although the teacher-student interaction model is conventional, it still ensures a certain level of participation. The research suggests that teachers should adopt task-based teaching methods, utilize questioning strategies, provide feedback mechanisms, and implement classroom participation structures to enhance both student participation and language learning outcomes.

Shi (2015) carried out a four-month experiment. After a comparative study of interactive whiteboard classroom and traditional multimedia classroom, it was found that students' learning interest in the interactive whiteboard learning environment was significantly improved, the interaction between teachers and students was more frequent, and the degree of learning involvement was far higher than that in the traditional projection teaching environment.

Although these studies have different focuses, they reveal the multi-dimensional influencing factors of learning engagement. The research adopts a variety of methods such as questionnaire survey, observation, interview, and experiment, which reflects the diversity of research methods. The study subjects covered different educational stages and were distributed in different cultural and social environments, which increased the applicability of the study conclusions. At the same time, the research also has certain defects. For example, the research data of Hu and Kuh (2002) came from a single source and mainly relied on students' self-reported data, which may be affected by the subjectivity of the reporter and lead to data bias. At the same time, longitudinal data is lacking, and the study does not track the change in students' learning engagement over a long period of time, so the long-term effects of influencing factors cannot be determined. Shi's (2015) research primarily focused on the effectiveness of interactive electronic whiteboards, possibly neglecting the influence of alternative teaching technologies or methodologies, like flipped classrooms and project-based learning. Additionally, most studies did not adequately address the changing educational landscape over time, including shifts in education policies, curriculum updates, and modifications to assessment systems. These factors could affect the current relevance of the findings. Future research should adopt a more diverse approach, taking into account differences across education stages and cultures, to gain a more comprehensive understanding of the factors that influence learning engagement.

# 4 THE INFLUENCE OF THE APPLICATION OF DIGITAL TEACHING MATERIALS IN THE CLASSROOM ON STUDENTS' LEARNING ENGAGEMENT

The quick progress of information technologies has significantly changed the situation in which digital teaching materials are perceived in the classroom. Such resources not only change the game for conventional teaching strategies but also have a huge impact on how the students are engaged in the learning process. This paper intends to examine how digital textbooks influence the level of engagement in learning activities of students from different educational levels and cultural backgrounds. It also evaluates the strengths and limitations of the current studies on the topic.

## 4.1 Literature Review

Huang's study focused on fifth and sixth-grade Chinese primary school students (Huang, 2016). By integrating surveys, interviews, and classroom observations, the research examined both emotional and behavioral aspects of students' learning engagement. Engagement was categorized into four dimensions: positive and negative emotional engagement, as well as positive and negative behavioral engagement.

Zhang and colleagues investigated 82 Chinese college students using a combination of surveys and experimental methods (Zhang et al., 2019). Their semester-long teaching experiment, which included pre-tests and post-tests, assessed how digital teaching materials (comprising touch projection all-in-one devices, interactive recording and broadcasting systems, intelligent learning behavior data collection and analysis systems, etc.) influenced classroom engagement among college students.

Thomas (2017) studied 54 American college students aged between 18 and 57, with an average age of 24.83 years. Through questionnaire surveys and experimental methods, the impact of digital game-based textbooks on students' learning engagement was explored. In the experiment, the control group and the experimental group utilized traditional paper textbooks and digital game-based textbooks respectively. The researcher measured the degree of Mental Effort of the students through self-reporting scales and recorded the actual time spent by the

students when reading the textbooks using a stopwatch. Compared to students using traditional paper textbooks, those using digital game-based textbooks invested more mental effort and spent longer periods on learning. This indicates that digital game-based textbooks, as a learning tool, can effectively increase students' learning engagement. The research findings also support the DGBL theory (Digital Game-Based Learning, a learning approach that combines game design with instructional design) and offer a feasible alternative to traditional paper textbooks for higher education institutions.

Moundy, K., Chafiq, N., & Talbi, M. (2021) selected 352 first-year students from Moroccan secondary schools, categorizing them into science and literature groups. A quantitative research methodology was adopted, and through the comparison between the experimental group and the control group, the influence of digital textbooks on student engagement was analyzed. Among them, five science classes and four literature classes constituted the experimental group, which utilized digital textbooks for learning. One science class and one literature class formed the control group, which employed digital textbooks in the first semester but not in the second. The research findings indicated that digital textbooks can greatly increase the levels of student engagement. Following the experimental group's use of digital textbooks in the second semester, their level of engagement increased by 57.1% on average. The research also found that the improvement of student involvement gained from digital textbooks could eventually lead to better academic achievements, which in turn create a positive feedback effect on the whole process. Moreover, the engagement of students in the science group when using digital textbooks was higher than that of students in the literature group.

Allred, J. B., & Murphy, C. A. (2019) focused on 38 American college students. They collected students' usage data through the interactive e-textbook software (MindTap), encompassing login time, engagement, and the number of interactive activities accessed, to measure students' behavioral engagement. Simultaneously, they combined questionnaire surveys to comprehend students' perceptions of e-textbooks, including aspects such as convenience, comfort, and learning efficacy. The research discovered that interactive e-textbooks can effectively enhance students' interest in learning and engagement, promoting active learning. Students hold positive attitudes towards the convenience and comfort of e-textbooks, but their opinions on learning effectiveness are divergent.

Leng and Yi (2020) selected 150 middle school students across 10 different classes. They utilized video analysis techniques to code and evaluate the students' engagement in classroom learning through recordings of various subject lessons. This approach was taken to assess how effectively digital textbooks were being used in smart classrooms.

## 4.2 Research Conclusions

### 4.2.1 Positive Impacts

Increase learning participation opportunities: digital educational materials allow teachers to incorporate all kinds of assessment methods, teaching practices, and devices into their lessons, and this enhances students' learning experiences overall. Huang (2016) established that digital textbooks in smart classrooms encourage students to participate in class interaction significantly more. According to Zhang et al. (2019), interactive teaching resource materials such as digital teaching tools contribute to peer collaboration and assessment, thus enhancing interactions between teachers and students.

Enhance Learning Initiative
Innovative teaching strategies and media fostered by digital teaching materials act as a magnet toward the deep involvement of the learners, thus accentuating student-centered learning. Thomas (2017) pointed out that learners using digital game-based textbooks tend to exert more effort while studying, as the book promotes active engagement. Just as Allred and Murphy (2019) have shown, e-textbooks powered by interactivity are helpful in growing students' engagement and increasing their participation.

Improve Positive Emotional Experience: the dynamic presentation and interactivity of digital textbooks can stimulate positive emotions, leading to greater classroom participation. Huang (2016) discovered that digital textbooks enhance students' positive emotional experiences and encourage active involvement.

### 4.2.2 Negative Impacts

Distractions Resulting from Improper Use of Devices for Learning Purposes: ducational gadgets, such as iPads, that offer a wide range of entertainment options, may overwhelm a student's attention to academic work. Huang (2016) emphasized that many smart classrooms, especially in elementary schools, share a common issue. These require not only devices but also a coherent learning strategy and a direction.

Yet, learning how to use these devices effectively remains a challenge.

Gender-Related Differences Regarding Distinction in Learning Attitudes: Huang's (2016) study revealed some intriguing insights regarding the way boys and girls interact with digital teaching materials. More precisely, boys demonstrate more negative learning behaviors, such as sleeping in a class or acting distantly toward educational tasks, compared to girls. This suggests that students' immersion in digital teaching resources might be related to their gender identity.

Varying Levels of Impact Among Students: according to the study by Moundy et al. (2021), while it was the case that many students displayed increased learning engagement with digital teaching materials, some others remained significantly less engaged with digital resources. The disengagement of underprivileged students may be caused by a variety of factors unique to their lives. A dwindling sense of motivation, insufficient access to the technology that is sometimes considered necessary, and the complex nature of their family environment can all contribute to this lack of motivation. The study also draws our attention to an important fact: digital textbooks do not always produce the same good results for all students. On the contrary, it is the document that reveals both the nature of the differences among the students and the teaching strategies that must be adopted in light of these differences in order to meet the needs of the students.

### 4.3 Comparison with Existing Research

Assessment through a Cross-Age Comparison: the studies of Huang (2016) and Zhang et al. (2019) prove that digital teaching materials are useful for students of different ages, even if the particular effects are different among the varying student groups. While elementary students need more assistance from teachers, high school students are capable of operating without direct supervision. According to Thomas (2017), digital textbooks especially stimulate students' motivation, and this is done by integrating games into teaching content.

The Spectrum of Technological Tools Available: differentiations in the instrumentations of e-textbooks used in the research are apparent. Huang (2016) focused on iPads, while Zhang et al. (2019) turned to several digital textbooks in the situation of smarter classrooms. Thomas (2017) delved deeper into his game-based teaching approach. Lastly, Allred and Murphy (2019) went for interactive e-textbook software. These factors affect the methods and intensity of how students engage and learn.

### 4.4 Research Limitations and Deficiencies

Sample Constraints: most studies have small sample sizes and are geographically limited, reducing generalizability. For instance, Huang (2016) and Zhang et al. (2019) focused their examination on single schools. Therefore, future studies can increase the sample size and scope, incorporating several districts and schools.

Monotony of Research Methods: some research may be done using various methods, whereas others can only be done with a single technique. For instance, Moundy et al. (2021) primarily used quantitative procedures without supportive qualitative evidence. The consideration of both approaches would thus make the comprehension of the subject wider.

Neglect of Individual Differences: despite the fact that a few researchers have acknowledged gender differences and minorities' involvement, the differences among individuals have not been sufficiently examined. What also remains to be investigated are the different segments among pupils (e.g., genders, learning styles, family background), if the goal is to educate them individually and correctly.

### 4.5 Summarization

The addition of digital teaching materials has had a favorable effect on student learning and engagement by making inclusion possible, cultivating initiative, and generating encouraging emotional experiences. Nevertheless, issues related to device abuse, gender discrimination, and the lack of equipment have to be resolved. The future research agenda should include larger sample sizes, varied methods, effects over the long term, and explorations of individual differences in order to more fully grasp and support the best practices in the use of digital textbooks in education.

## 5 CONCLUSION

In the course of reviewing all pertinent research outputs, the agreement appears that digital educational materials have indeed proved to be a forbearance of stimulating student engagement in the learning process. Nevertheless, alongside these advantages, several problems caused by the rapid

development of digital technology and some of their unavoidable limitations also become apparent.

Digital teaching materials are capable of effectively capturing students' attention and stimulating their interest in learning by offering interactive content and multimedia elements. This interactivity assists students in maintaining focus during the learning process and actively participating in classroom activities. Simultaneously, digital teaching materials provide a platform for self-regulated learning, enabling students to undertake personalized learning based on their own learning pace and style. This capacity for self-regulated learning is of paramount importance for nurturing students' learning habits and lifelong learning capabilities. Furthermore, digital teaching materials can facilitate students' better comprehension and mastery of knowledge by providing diversified learning resources and assessment approaches. This multi-faceted learning experience contributes to enhancing students' learning outcomes and promoting their comprehensive development. To sum up, multimedia teaching materials have a positive influence on all aspects of the positive development of students' learning.

Nonetheless, the effective utilization of digital teaching materials is contingent upon a stable technological infrastructure and equipment. In some regions, the insufficiency of technological resources may restrict the dissemination and application of digital teaching materials. There might also exist disparities in digital skills and device usage among different student groups, which could potentially give rise to a digital divide. Educators are obligated to adopt measures to ensure that all students have equitable access to and utilization of digital teaching materials.

Moreover, teachers need to adapt to the use of digital teaching materials and master relevant teaching strategies and technical tools (Huang, 2016). While focusing on technical proficiency, attention should also be paid to teachers' ability to apply information technology. This requires teachers to receive continuous training and support to ensure they can effectively utilize digital teaching materials to promote students' learning.

In order to fully exploit the potential of digital teaching materials and overcome their limitations, the author put forward the following suggestions:

Strengthen the construction of technological infrastructure: schools and educational institutions should invest in the establishment of technological infrastructure to ensure that all students have access to necessary equipment and technical support.

Narrow the digital divide: educators should undertake measures to assist all students in acquiring necessary digital skills and ensure their equal access to and utilization of digital teaching materials.

Provide teacher training and support: educational institutions should provide onboarding and continuous training for teachers on the process of utilizing digital teaching materials and developing impactful teaching strategies.

Alongside the current digital instructional materials, digital resources may prompt future education research topics in the following directions, based on the conduct of this study:

These directions include utilizing interdisciplinary research to explore the multifunctional use of digital learning tools across multiple learning and teaching domains and studying their effective integration into other methods and pedagogical solutions for innovative interdisciplinary education. Future research should also aim at the implementation of longitudinal studies to monitor changes in learners' academic performance and learning engagement after using digital teaching materials for a specific period. This would help to assess the long-term effects that these materials exert on students in the future.

Moreover, there is a need for educators to learn how to design digital instructional materials and implement teaching methods that meet the children's individuality and vary according to their learning styles, making the learning process more enjoyable and fruitful.

Additionally, research should focus on the influence of digital teaching materials on marginalized groups and explore how to increase their learning engagement and achievements through digital teaching materials to promote educational equity. Efforts should also be directed towards developing digital teaching materials based on artificial intelligence technology, making use of the intelligent and personalized characteristics of AI to create more advanced and student-demand-adapted teaching resources.

Therefore, digital teaching materials are likely to change the way teaching is delivered in the classroom and promote the engagement of students in effective learning processes. However, problems do often arise, and these challenges can be tackled through the training of teachers, individualized learning, parental cooperation, and infrastructure development, thus enhancing the potential of digital teaching materials and bringing about the best outcomes for pupils.

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