The Effects of Tablet Use on Student Learning Achievements, Participation, and Motivation at Different Levels

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ABSTRACT

The incorporation of tablets into education has become widespread in recent years. Their use enables learners to gain access to a plethora of learning resources. Nevertheless, reasonably little has been done to systematically review the effects of tablet-assisted learning on student learning achievements, participation, and motivation. In this study, both the positive and negative effects of tablet-assisted learning were explored. In addition, the motivational elements of tablet-assisted learning were discussed, coupled with an analysis of its effects on motivation and gender differences in tablet use. The roles of tablet use in learner participation and ways to enhance learner participation were also studied. Additionally, the authors discussed the impacts of tablet-assisted learning at different grade levels and provided constructive suggestions for technologists and educators. Further research should carry out empirical investigations with large samples or by combining tablets with gamification to identify more factors affecting tablet use and address the existing problems.

KEYWORDS

Education, Effects, Grade Level, iPad, Learning Achievements, Motivation, Participation, Tablet Use

INTRODUCTION

Mobile learning (m-learning) has been increasingly adopted in the teaching discipline. In turn, researchers have been committed to exploring the significance of integrating mobile devices in teaching (Haßler et al., 2015). Definitions of m-learning vary based on the characteristics. Early researchers perceived m-learning as a learning method supported by mobile computers, MP3 players, personal digital assistants (PDAs), smartphones, or tablet personal computers (Keskin & Metcalf, 2011). Recent researchers have focused on the mobility and ubiquity of m-learning and its associated devices (Mulet et al., 2019; Yu et al., 2020). These characteristics of m-learning have catapulted the evolution of technological learning into a new phase.

Prior to 2010, common mobile instruments for use in teaching included smartphones, personal computers, and PDAs. Tablets, which first appeared in 1989, became commercially available in 2002. The popularity of tablets increased with the launch of Google's Android-based tablets (2009) and the Apple iPad (2010).

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Tablets, or tablet computers, integrate several sensors or components (e.g., global positioning system [GPS] and built-in cameras) into a single device. A tablet is a wireless touch-screen personal computer without a keyboard or mouse. The tablet features a lightweight structure, autonomy, long battery life, and lower price compared to other computing devices. According to Nouri and Pargman (2016), in pedagogy, tablets help learners perform consultation tasks (e.g., searching for information online) and production tasks (e.g., making videos and designing creative mappings). Their portability and small size enable learners to perform interactive learning, such as communicating and collaborating, on tablets after class (Mulet et al., 2019). Thereby, assisted by tablets, learners can learn both in and out of the classroom. More importantly, they can access multimedia learning resources.

The first studies on tablets in teaching occurred in 2004 (e.g., Anderson et al., 2004; Golub, 2004; Simon et al., 2004), centering on the tablets' advantages, uses, and benefits. Considering the popularity, researchers from different fields began to focus on the effects of tablets on learning. By comparing the studies, there is found to be an absence of a systematic review of tablet use effects on students' learning achievement or effectiveness, participation, and motivation (Sage et al., 2019; Mayer, 2019).

LITERATURE REVIEW

Research Trends

The research of tablet-assisted learning and teaching has been a hot topic for a long time. The authors selected *topic* as the search word to avoid ignoring significant information. The search obtained 4,185 results by inputting (tablets* or iPad*) *AND* (learn* or educat*) in databases. It analyzed a citation report automatically (see Figure 1). According to column chart, citations from 2008 to 2010 remain virtually unchanged. The year 2009 witnesses the least publications (N = 9) over the whole period; the number of publications reaches its zenith in 2017 (558). The number of citations grows moderately from 2010 to 2013. The publications were featured by an increase trend, climbing from 18 in 2010 to 285 in 2013. The curve graph demonstrates a dramatic growth in the number of citations for nine consecutive years (2013 to 2021). Additionally, both the number of citations and publications slump in 2022 because the year is just getting started.

Figure 1. Times cited and publications over time
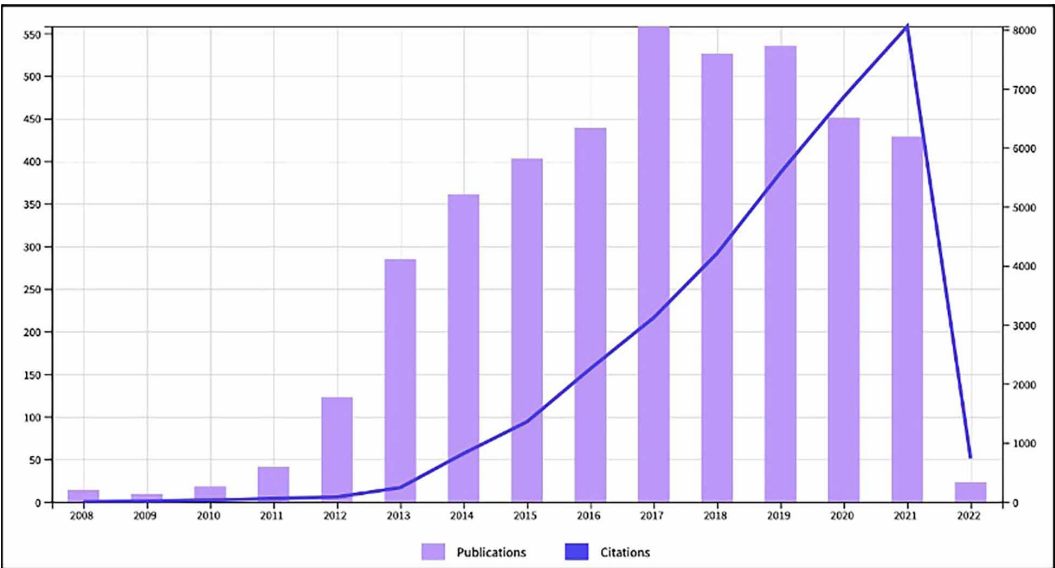
Learning Achievements and Participation

Learning achievements generally refer to academic performance, problem-solving and comprehensive thinking abilities, learning perceptions and behaviors, and learning efficiency (Yu et al., 2020). A range of studies have examined the correlation between learning achievements and student participation. The research has concluded that participation in mobile learning is highly correlated with different learning achievements (Boulton et al., 2018; Cerezo et al., 2016). Educators and researchers conceive that student participation acts as a key to improving academic success and decreasing learning boredom and failure rates (Fredricks et al., 2004). Moreover, student participation is one of the most significant predictors of learning achievements. Thus, more activity and student classroom participation will impact the retainment of knowledge, progress, and pleasure in learning (Jones & Lee, 2022; Soffer & Yaron, 2017).

Class participation is essential for meeting expected learning achievements. Student participation affects both learning achievements and creativity (Wakefield et al., 2018). Students who participate in class have more potent learning abilities, creativity, and greater passion (Bogami & Elyas, 2020). In contrast, those who do not participate in class often skip class and complete classwork with little concentration or excitement. The plight in education is not students' low achievement; it is their lack of participation (Newmann, 1992). Moreover, quality of evidence was downgraded due to the imprecision, inconsistency, and limitations of the study. Hence, the current study should further explore students' learning achievement and participation in tablet-based pedagogical approaches.

Tablet-Assisted Learning and Motivation

Many studies consider motivation as crucial in mobile learning because it stimulates, guides, and fosters improved performance (Cho & Castañeda, 2019; Ushioda, 2013; Yu et al., 2020). Motivated students tend to exert efforts to learn and persist when faced with challenging learning processes. Some researchers posited that mobile devices could strengthen students' motivation (Wu et al., 2012; Cho & Castañeda, 2019). For example, some students are motivated to learn English on a smartphone after class without being assigned the task (Sandberg et al., 2011). Moreover, studies have explored how mobile-assisted language learning affects students' motivation and learning achievement. It has been implied that integrating mobile devices into the learning process could increase learning effectiveness and motivation (Kim et al., 2013; Liu & Chu, 2010).

This study systematically reviews the effects of a tablet-based teaching approach on students' learning achievement, participation, and motivation. Learning achievements correlate with motivation and participation; therefore, all three factors could be improved by tablet-assisted learning. Hence, this study will explore the effects of tablet use on learning achievements, motivation, and participation. The authors propose the following research questions:

1. What are the impacts of tablet-assisted learning on learning achievements?
2. What are the impacts of tablet-assisted learning on motivation?
3. What are the impacts of tablet-assisted learning on participation?

RESEARCH METHODS

This section details research approaches and design through a rapid evidence review. The authors used inclusion and exclusion criteria to select articles and provide the result of the discovered evidence.

Research Corpus

Following the study by Kassab et al. (2020), this study developed a protocol prior to its search (January 2022). Figure 2 illustrates the five processes of literature selection: (1) literature search; (2) keywords clustering; (3) literature screening; (4) eligibility assessing; and (5) results refining. When selecting

Figure 2. Literature selection process
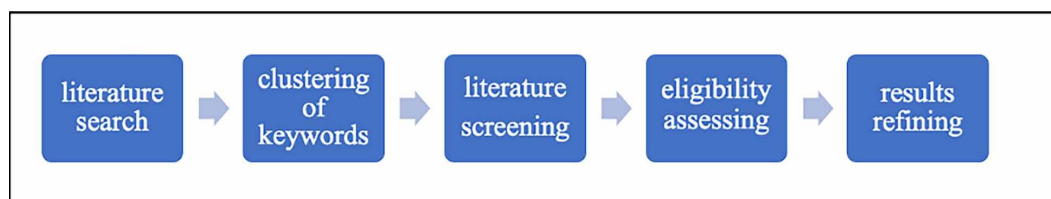
literature, the authors selected *topic* as the search word to avoid ignoring significant information. The study obtained 4,185 results by inputting (tablets* or iPad*) *AND* (learn* or educat*) in databases like Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index- Science (CPCI-S), Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH), Emerging Sources Citation Index (ESCI), Current Chemical Reactions (CCR-EXPANDED), and Index Chemicus (IC).

Irrelevant results and literature with low quality were removed. Research fields were refined to "Education and Education Research." The authors' 1,515 results were clustered via the Vosviewer program.

A map was created based on the bibliographic data from Web of Science. The authors chose *co-occurrence* as a type of analysis, *All keywords* as a unit of analysis, and *full counting* as the counting method. The authors set the minimum number of occurrences of a keyword at 10. Of the 4,163 keywords, 98 met the threshold with 1,649 total link strength. The total link strength of each item was calculated. The network visualization is displayed (see Figure 3).

The keywords were classified into five clusters with 98 items.

Cluster 1: 27 items, including vocabulary, writing, reading, flipped classroom, and language.
Cluster 2: 25 items, including engagement, innovation, collaborative learning, and flipped class.
Cluster 3: 22 items, including attitudes, perceptions, self-efficacy, beliefs, and acceptance.
Cluster 4: 17 items, including achievement, engagement, participation, and performance.
Cluster 5: 7 items, including gamification, motivation, and acquisition.

The keyword with the greatest total link strength is engagement (N = 100). The total link strength (N = 80) of motivation is the second top item. Items like performance or achievement have a strong link strength (N = 72). The clustering process, hence, displayed that engagement, motivation, and performance or achievement have been important themes.

Search Criteria

A mixed searching strategy (manual and automated searching) was adopted. The study ran its search on the Web of Science. It searched data through the Boolean search method. The study chose "tablet* or iPad*" term, achievement* or performance, engagement* or participation. Motivation was the *title*. The study refined its research fields to "Education and Educational Research field." The term "iPad" was used as an alternative term for "tablet" because the authors noted that some studies related to mobile devices used "tablet" and others mentioned the term "iPad" specifically.

In January 2022, the authors adopted the inclusion and exclusion criteria to filter for high-quality publications. This ensured the relevance of the searched literature. Papers were searched according to these criteria. Figure 2 depicts the process of the literature selection. The authors obeyed the guidelines to assess the quality of the literature proposed by Snyder (2019). Figure 4 is the detailed literature selection in each step.
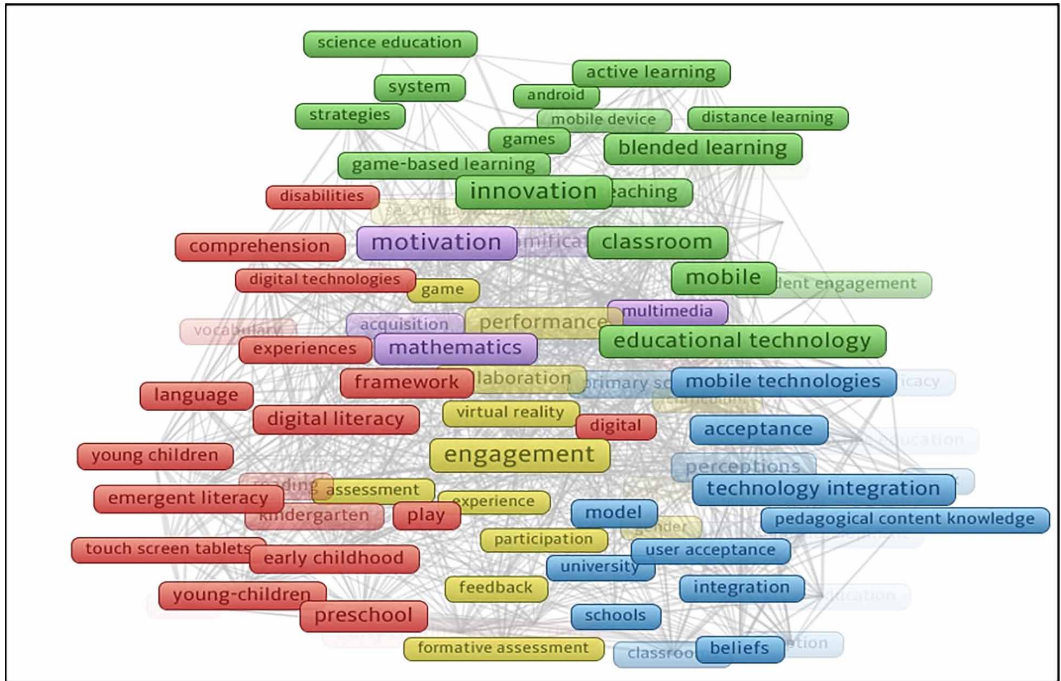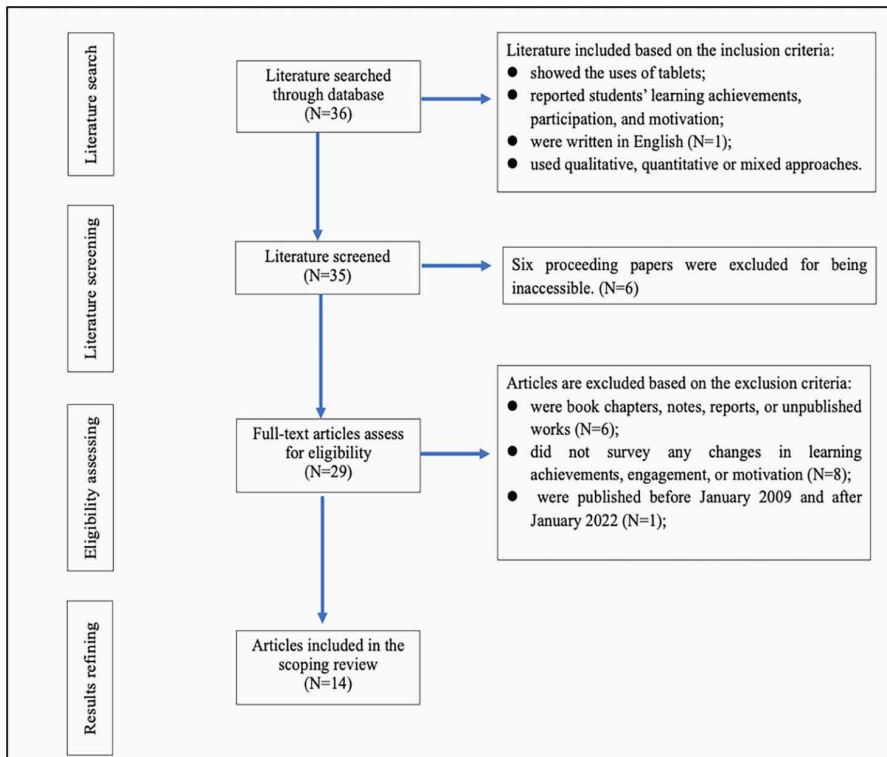
Figure 3. Clustering of keywords

Figure 4. Detailed literature selection in each step

Studies were included if they: (1) showed the use of tablets; (2) reported changes in leaners' learning achievements, participation, and motivation in tablet-based learning in any learning context; (3) were published between 2009 and 2022; (4) were written in English; and (5) used qualitative, quantitative, or mixed approaches.

Studies were excluded if they: (1) were book chapters, notes, reports, or unpublished works; (2) did not survey learning achievements, engagement, or motivation in the tablet-based learning context; (3) were published before January 2009 and after January 2022; and (4) could not be accessed through university services or memberships (Ramdhani et al., 2014). After generalizing the 36 retrieved articles, the authors determined 14 as the main citation (see Table 1).

RESULTS

This section presents the impacts of tablets on learning achievement, participation, and motivation after reviewing and analyzing previous studies.

Table 1. Characteristics of the refined studies

No.	Authors	Foci	Major Findings
1	Aldossry (2020)	Contrast between traditional teaching and iPad-assisted teaching	The iPad may make a difference in students' performance in mathematics.
2	Bluestein and Kim (2017)	Exploration of expectations and fulfillment	The tablet did not meet expectations in terms of course engagement and skills.
3	Dashti and Habeeb (2020)	Impact of iPads on students' collaboration and engagement	The iPad is neither an aid nor impediment to collaboration or skills development. It is, however, an alternative resource for childhood development.
4	Hart and Laher (2019)	Effects of tablets on learner achievement	Learner achievement is influenced by their attitudes toward tablets and enjoyability of use.
5	Hung et al. (2017)	Tablets used in university physical education	Tablets could be integrated into badminton courses to enhance learner motivation and badminton skills.
6	Kirkpatrick et al. (2018)	Impact of iPads on students' achievement	The use of iPads has mixed effects on language and mathematics. There were no significant effects on students' learning skills.
7	Lombard et al. (2021)	Identification of students' performance on tablet reading	Students who read under tablet guidance outperformed those who used traditional pdf viewers.
8	Jin and Lin (2021)	Identification of tablet use and attention performance	More time using tablets could lead to faster reactions and better attention performance.
9	Kang (2018)	Effects of tablet-based instruments on students' motivation and preferences	Students prefer acoustic instruments to tablet-based instrumental modes.
10	Min et al. (2020)	Effects of iPad use on phonics performance	Students made significant growth in phonics performance.
11	Remón et al. (2017)	Effects of tablet user on learning outcomes and engagement	Tablet use could increase students' learning and engagement.
12	Soffer and Yaron (2017)	Effects of tablet user on participation and effectiveness	Students report positive attitudes toward tablet use. Positive perceptions are significantly associated with students' learning effectiveness.
13	Mona (2018)	Effects of learners' drawing performance on tablets	Participation and focus on drawing tasks increased when students used tablets rather than paper.
14	Yamaç et al. (2020)	Effects of tablet use on students' writing performance and literacy	Tablets could enhance writing quality and new literacy as compared to traditional modes.

RQ 1: Impacts of Tablet-Assisted Learning on Learning Achievements

Positive Effects of Tablets on Learning Achievements

Mobile devices, such as smartphones and iPads, can promote accessible communication between learners and instructors. This technology allows users to search for complementary information, as well as arrange study processes and teaching practice.

Many studies have found the effectiveness of tablet use in different educational fields (Aldossry, 2020; Hung et al., 2017; Yamaç, 2020). Aldossry (2020) noted that iPads could make a difference in secondary school students' performance levels in mathematics. Teaching approaches adopted by mathematics teachers can incorporate iPads into lessons to contribute to learning achievements. In addition, according to Hilton (2016), iPad use in mathematics could significantly impact students' perception and engagement. In terms of physical education, integrating the use of tablets into badminton courses could enhance students' performance and skills (Huang et al., 2017). Tablet use empowers students to change their overall perspectives when learning badminton skills, as well as provide immediate feedback for improvements. Regarding language arts, students who struggle with reading could see improvements in phonics performance, maintain intervention gains, and promote language learning skills (Min et al., 2020).

Researchers have found that tablets have a positive effect on writing achievement. Some primary school students who used tablets demonstrated more writing improvement compared to those without tablets (Lowther et al., 2001, 2003; Silvernail & Gritter, 2007). The use of tablets could enrich students' writing literacy. According to a quantitative and qualitative study by Yamaç (2020), elementary school students with tablet-assisted instruction outperformed students with paper and pen in writing quality and number of words. During the writing process with tablets, students could develop writing and research skills related to content planning and design, structure framing, sentence construction and review, and evaluation. Applications (apps) can be adapted in tablets to develop students' comprehension of multiple documents. In contrast, viewers of traditional files (like a pdf) can only develop this skill under certain guidance (Lombard et al., 2021). Furthermore, on tablets, students work more efficiently on multiple reading tasks.

Negative Effects of Tablets on Learning Achievements

Digital devices (i.e., smartphones, computers, and tablets), when used as a means of amusement and intercommunication, can improve students' learning effectiveness. Some studies, however, have illustrated underlying adverse effects of digital devices on learning achievements, including disruptions when students read or answer online messages or surf the Internet. Problems with Wi-Fi connectivity may frustrate or distract students (Bluestein & Kim, 2017; Kirkpatrick, 2018). Besides, teachers' abilities to integrate tablets into instruction will also affect pedagogical achievements (Armstrong, 2011). Beyond these issues, some students expressed that desktop computers are easier to operate. The students reported that iPads did not meet their anticipated needs regarding class engagement and skills (Bluestein & Kim, 2017). Thus, technology use could also be negatively associated with students' learning achievement.

Controversies

There is much debate over the impacts of tablet-assisted learning and teaching. Some studies have compared students' learning achievement under conventional teaching vs. technology-based teaching. Dashti and Habeeb (2020) undertook a qualitative analysis of kindergarten students' drawing performance on tablets vs. paper. The major finding was that the tablet was neither an aid nor a hurdle to cooperation, scaffolding, or skill growth. However, it was a smart way to promote early childhood development. Another study revealed that the impacts of tablet use were mixed regarding language and mathematics learning (Kirkpatrick, 2018). Positive, negative, and neutral effects were produced. Moreover, students' learning skills were not significantly developed. This finding is in alignment

with a previous study in which students who learned about solar cells via iPads performed as well as those who learned on desktop computers. Furthermore, a recent study indicated that tablet-assisted learners performed worse on the human bloodstream than the desktop computer-assisted learners (Kassab et al., 2020).

These studies reveal that the advantages offered by iPads may be challenged even if tablets could increase the self-efficacy of students. However, these are not supporting proof for proponents of tablet-assisted learning. Arguments still exist. Still, some researchers posit that tablet use could improve students' learning achievement due to the dearth of pedagogy-wide and sufficiently long research works.

RQ 2: Impacts of Tablet-Assisted Learning on Motivation

The special attributes of tablets (i.e., touch-screen interfaces, intuitive operating systems, portability, and large supporting apps) empower students regarding motivation, knowledge comprehension, and performance.

Role of Motivation

Numerous studies have found motivational effects of tablet use on learners. Some have speculated that such devices could improve learner motivation and, subsequently, enhance learning skills (Hung et al., 2017). Motivation concerning tablet use varies, such as course completion, curiosity pleasing, and social connections. Higher motivation would allow tablet-assisted learners to learn autonomically (Yamaç, 2020). In addition, motivation could reduce students' learning anxiety and embarrassment in tablet-assisted learning. Motivation is positively correlated with learning practice, performance, and satisfaction (Yu et al., 2020).

Elements of Motivation in Tablet Use

Malone and Lepper (1987) proposed six elements to enhance learner motivation (i.e., challenge, curiosity, control, cooperation, competition, and recognition). Their motivation theory might shed light on motivational tablet-assisted effects:

1. **Challenge:** Tablets allow learners to track their progress across the study (Min et al., 2020). Learners could use tablets to overcome reading difficulties regarding phonics, word identification, and reading fluency. Tablet-integrated phonics teaching might increase students' motivation to face challenges and improve their phonic knowledge. Furthermore, tablets enable learners to search for additional educational resources on obscure or different topics (Hart & Laher, 2019). If learners perceive the usefulness of tablets, they may be more motivated and, in turn, improve in their performance. Thus, tablets could provide continuous motivation if learners perceive an enjoyable learning experience (Yu & Yu, 2019).
2. **Curiosity:** Multimedia effects brought about by tablets (i.e., games, videos, audio, music, animation, and interactive functions) could arouse learners' sensory curiosity (Ciampa, 2014; Liu et al., 2009). The experience of touching a tablet's screen can address cognitive curiosity in terms of haptic touch. Both sensory and cognitive curiosity can motivate learners to explore new knowledge and gain competence.
3. **Control:** Tablets enable "anywhere, anytime learning and teaching," assisting learners in self-discipline beyond the level found in conventional classrooms. Through tablet-assisted learning, users could control their learning process, self-reflect, and self-examine (Hung et al., 2017). Besides, tablet use could affect self-regulatory writing from text generation, transcription, and executive function (Yamaç, 2020).
4. **Cooperation:** Cooperation is perceived as engaging individuals to collaborate and achieve a specific goal (Malone & Lepper, 1987). Tablets, as a tool, can offer a more interactive and

cooperative learning context (Hart & Laher, 2019). Tablets create a learner-centered environment in which learners can learn, cooperate, and receive critical feedback. Learning cooperation on iPads in a kindergarten setting could yield meaningful contributions to story making and, in turn, generate more cooperation (Dashti & Habeeb, 2020). The natural appeal of tablets could also facilitate children's collaborative mutual scaffolding of knowledge.

5. **Competition:** Competition exists when two or more individuals have opposing goals (Malone & Lepper, 1987). Tablets, as mobile technology, have a diverse range of apps, including competitive multiple-level tasks (Hilton, 2016). Competitive elements in tablets play a significant role in motivation because some learners regard challenges as opportunities. Users may enjoy the competition and have fun participating in competitive activities (Yu et al., 2020; Zhang & Yu, 2021).

6. **Recognition:** Learners want their achievements and efforts to be recognized and perceived (Malone & Lepper, 1987). The visibility of learners' behaviors can motivate quiet learners to engage in group activities. Tablet screens can encourage diffident learners to overcome shyness. The participation will improve students' knowledge skills and self-recognition (Min et al., 2020).

Gender Differences

Some studies have explored gender differences. For example, researchers have found that girls are more motivated and likely to accept tablets as learning tools (Gokcearslan, 2017; Mulet et al., 2019). On the other hand, some researchers have noted that boys hold a more positive view on tablet use. Boys appear to enjoy learning mathematics on tablets (Hilton, 2016).

RQ 3: Impacts of Tablet-Assisted Learning on Participation

Roles of Tablet-Assisted Learning on Participation

Studies have found greater student participation based on extended use of tablets, perceived ease of use, and exploration of table chat features (Soffer & Yaron, 2017). Participation could act as a mediator in perceived learning and knowledge processing under tablet-assisted learning. Apps that feature cooperation and interaction can boost students' motivation, attention, and participation while learning (Min et al., 2020). Participation is coupled with tablet-assisted learning from educational, technological, and interactional aspects.

The following three factors that arise from tablet use could improve learner participation: (1) self-discipline; (2) enjoyability of use; and (3) gamification. Learners' motivation and engagement improve when they control their learning pace (Hung et al., 2017). Enjoyability, as an attitudinal component, contributes to learning through challenge, curiosity, recognition, competition, and cooperation. In turn, the use of tablets is more enjoyable (Hart & Laher, 2019). Interestingly, students are more likely to engage in game-based apps, suggesting that gamification in tablet use could also affect learner participation (Yu et al., 2020; Zhang & Yu, 2021).

Tablets with interactive and collaborative features play a role in engaging learners through a blended learning context. This is thought to be a more efficient pedagogical approach (Lombard et al., 2021). Tablets have been identified to increase performance, attentiveness, and organization of learning resources. Furthermore, the provision of tablets offers an effective way to transform heavy books into cost-effective e-textbooks.

Means of Enhancing Participation

Personal and environmental factors influence engagement in technology-assisted learning, including motivation, type of focus, and design interventions (Panigrahi, 2018). Interest and self-adjusting are positively associated with emotional participation, with interest being the most significant element (Sun & Rueda, 2012). The introduction of game-assisted learning on tablets might motivate learners and improve their participation.

Promotion and prevention are two factors of focus that influence learners' participation (Arazy & Gallatly, 2012; Panigrahi, 2018). Promotion pushes learners to participate for further progress and success; prevention guides learners from careful participation and safety to avoid negative results. The encouraging integration process (from easy to difficult tasks) on tablets might reduce learners' prevention focus and engage them in diverse learning activities (Panigrahi, 2018).

Design interventions on tablets are significantly and positively correlated with learners' participation. These include the ways learners use tablets, cooperation and interaction, pertinence and quality of curriculum, and instructor assistance. Interventions are essential for stimulating participation to achieve expected learning effects (Khan et al., 2017).

Controversy

Interestingly, learners' attitudes toward tablet-assisted learning are not significantly high regarding participation. In fact, this is not consistent with studies in which tablet-assisted learning could increase participation (Soffer & Yaron, 2017). This might be because learners are used to existing technology-assisted learning tools; therefore, their learning experience with those tools is identical. Another explanation may be that uncontrollable factors (i.e., technical problems, unstable networks, and bugs) are experienced by learners in the learning process.

DISCUSSION

Impact of Tablet-Assisted Learning on Students at Different Grade Levels

Learners generally tend to have positive perceptions of tablets. Nevertheless, attention should be paid to grade levels and tablet-assisted learning.

Impact of Tablet Use on Preschool Children

The preschool and kindergarten age are generally three to six years (Jin & Lin, 2021). In this developmental stage, children typically grow and develop fast. At the preschool level, however, some children are not familiar with tablet use. They usually read and learn with the help of a guardian. Children may prefer iPads; however, they might be bored and disengaged if they work cooperatively and wait their turn (Dashti & Habbeb, 2020). The pleasant pictures on tablets' educational apps are favored by children, arousing their learning interests, imagination, and innovation. Time spent on tablets should also be noted. Preschoolers' overall accuracy rate and reaction times on tablets improve with age (Jin & Lin, 2021). The American Academy of Pediatrics recommends that tablet use should be no more than one hour per day.

Impact of Tablet Use on Primary School Students

Primary school learners have mixed perceptions regarding tablets. These learners favor tablets for many reasons, such as availability of learning resources, customized abilities in learning tasks, and learning pleasure (Huang et al., 2017; Prince, 2017; Soykan, 2015). Other students, however, do not learn through tablets. In fact, the screen is distracting and negatively affects social association (Kontkanen et al., 2017). In terms of tablets' technical characteristics, some students perceive the ease of use in reading or managing materials but report it is harder to do production tasks. Despite the advent of digital pens, which address writing issues, students may prefer to use books and pencils. More generally, both primary and elementary students are still developing in self-control and timing. Thus, tablet use may cause time loss and interrupt learning. Additionally, tablets may bring physical discomfort after long periods of use, resulting in visual fatigue, headaches, and eye pain.

In summary, the findings underscore that students' attitudes are complicated or contradicting. Attitudes will differ according to students and learning environments.

Impact of Tablet Use on Secondary School Students

According to the quantitative data (Bogami & Elyas, 2020), using iPads and other handheld devices in middle schools could motivate users to learn, stay on task, collaborate with the group, and improve their enjoyment. Overall, students will be enabled to be more independent learners. Applying tablets for reading and the teaching of vocabulary has significant importance on secondary students in the English as a foreign language (EFL) class because the apps bolster students' engagement and learning. Outdated, traditional teaching methods are factors behind low levels of performance and interest loss. Secondary school students reported more interest in game topic tasks on tablets. Students' immersion in games and activities is positively related with learning achievements (Zhang & Yu, 2021). Team game activities are also significantly correlated with team game performance. Further insights should be explored into secondary school learners' gamified activities among individuals and groups.

Regarding the moderately inverse correlation between physical activity and tablet use (Raustorp et al., 2020), attention should be paid to girls as they might be a potential risk group for insufficient physical activity.

Impact of Tablet Use on University School Students

Studies conducted at the university level reported that tablet-supported courses under instructor guidance might improve students' motivation, engagement, and learning performance (Albadry, 2015; Wakefield et al., 2018). Caution should, however, be exercised regarding learning content, context, and students' fear-of-missing-out emotion when students receive notifications (Dmitri et al., 2019).

Many researchers examined the acceptance, incidence, and use of tablets in higher education (Sevillano & Luisa, 2015). They found that tablet use positively impacts the development of generic competencies in higher education (for example, analysis and synthesis, communicative, digital, foreign language, mechanical, information processing, and technical competencies). Besides, it has a fairly significant effect on developing learning activities. University students' performance, effort expectancy, and self-efficacy are high when using tablets.

SUGGESTIONS

Tablet-Assisted Education Technologists

Many researchers have made commitments to the impacts of tablet-assisted learning. Few have shed light on educational app designs for tablets. Tablets are not explicitly designed for education (Wakefield et al., 2018). Their perceived usefulness, ease of use, and enjoyability bring opportunities for learning and teaching (Mulet et al., 2019). However, there is an increasing need for tablet-assisted education technologists to ensure the educationally sound and proper use of tablets at different grade levels (Yu et al., 2020).

Some studies reported existing technical restrictions with tablet use, including the inconvenience of transferring data from computers to tablets and disturbing advertisement notifications. In addition, limited charging locations in the school may decrease students' satisfaction with tablets (Hakan & Murat, 2014). Technologists should commit to increasing the effectiveness of tablet use by integrating memory sticks for data transfer, further prolonging battery life, and improving the ease of setting notifications (Kassab et al., 2020). Technologists should also make efforts to provide after-school information technology (IT) experience and game experience to learners (Yu et al., 2020).

Teachers

Despite the presence of technology-enriched learning environments, the teacher's role in the classroom cannot be eliminated (Mulet, 2019). Teachers should assess students' competencies and proficiencies as they select tablets and apps for student learning (Bogami & Elyas, 2020; Falloon, 2014). In terms of task fulfillment, teachers should be conscious of the risks and challenges of teaching tech-savvy

students (Kassab et al., 2020). Thus, it is recommended that teachers with technology fears and limited IT experience be trained to deal with students' technological demands, utilize tablets in the classroom appropriately, and use all available technology to help them build a sense of security and confidence (Bogami & Elyas, 2020; Haßler et al., 2015; Yu et al., 2020).

Teachers must recognize and understand what students expect from tablet-assisted learning. Accordingly, they should review and customize pedagogical methods in selecting appropriate apps, activity designs, and efficient ways to produce satisfying learning achievements. Predominantly, students favor active learning environments with playful interaction. Teachers can adopt game-like activities and establish a gamified learning environment to improve learner motivation and performance (Yu et al., 2020; Zhang & Yu, 2021). In addition, class activities should be relaxing and competitive to motivate learner engagement. Teachers can select shorter videos rather than longer videos because the former can increase curiosity and produce more satisfactory results (Ciampa, 2014; Yu et al., 2020). Audio, music, animation, and other interactive functions can be adopted to motivate learners to acquire knowledge.

CONCLUSION

This section will explore the major findings, study limitations, and suggestions for future research.

Major Findings

By reviewing a body of studies exploring the effects of tablet use on learning, this study discussed tablet-assisted learning achievements in terms of positive and negative effects and controversies based on a systematic literature analysis. Tablet-assisted learning has positive effects on students' performance levels in mathematics, physical education, language arts, and reading and writing. However, disruptive elements like Wi-Fi connectivity creates adverse effects in learning achievements. Controversies exist; however, some researchers posit that tablets could improve students' learning achievements. This is primarily due to the dearth of pedagogy-wide and sufficiently long research works.

In addition, motivational elements (i.e., challenge, curiosity, control cooperation, and competition) in tablet-assisted learning were explored, coupled with their effects on motivation and gender differences in tablet use. There are also gender differences in the motivation of using tablets. Boys appear to be more interested in tablet use and learning on tablets.

The current study analyzed the role of tablet use on participation and ways to enhance learner participation. Three factors could improve learner participation: (1) self-discipline; (2) enjoyment in use; and (3) gamification.

The study discussed the impacts of tablet-assisted learning at different grade levels. Constructive suggestions were provided for technologists, educators, and researchers.

Technologists should make every effort to provide after-school IT experiences and game experiences to learners. It is crucial for teachers to recognize and understand students' expectations regarding tablet-assisted learning. Researchers and programmers should explore influences of tablet use on affective states and better identify the hidden reasons and consequences.

LIMITATIONS

There are several limitations in this study. First, the authors had limited databases due to the inability to access global resources. Second, this study is based on content rather than statistically supported, which may reduce reliability.

IMPLICATIONS FOR RESEARCHERS

This study can pave the way for future research in teaching and learning regarding tablet use. It is suggested that future research empirically test a large sample and use other practical procedures in different disciplines (i.e., interviews with instructors and learners). The findings in this study may be replicable in many disciplines and learning contexts. It may serve as a route for future research to assess student exercise and individual activities. In addition, it can identify more factors that affect tablet use and address existing problems. Further research could carry out empirical investigations, such as those using questionnaires and interviews with large samples or combining tablets to gamification or blended learning to explore more profound topics.

Regarding learning achievements, participation, and motivation, the authors measured a limited number of effects. Future researchers and programmers may explore more influences of tablet use on affective states and better identify hidden reasons and consequences (Wang et al., 2022). The study's extensive review may depict a lack of research on several areas related to the education sector; hence, more research parameters are needed to establish a perspective to prove the usefulness or drawbacks of tablets.

Moreover, based on the conclusion, different disciplines have different challenges. Therefore, the use of tablets may add instructional challenges (Li & Yu, 2022). Tablets and handheld devices can benefit certain subjects; however, they may be challenging to other subjects. Researchers should pay more attention to the future of the tablet-based discipline.

ACKNOWLEDGMENT

CONFLICTS OF INTEREST

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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