



Effectiveness of multimedia tools in enhancing consonant-vowel-consonant reading performance and phonics interest and enthusiasm among kindergarten ESL students

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Abstract

In the ever-evolving landscape of education, the debate between traditional and modern instructional methods remains a focal point of discussion. The more technology is integrated into classrooms, the more it becomes imperative to scrutinize its effectiveness, especially in the foundational years of learning. Studying the association between multimedia tools and the consonant-vowel-consonant (CVC) reading performance of preschool English as Secondary Language (ESL) students is vital. The study explored the effectiveness of multimedia tools on CVC reading performance and interest and enthusiasm in phonics among Kindergarten Level 1 (K1) ESL students using a quasi-experimental design that lasted for eight weeks. Two enrolled classes were divided into traditional (14 participants) and multimedia groups (13 participants) according to their assigned classes. The study conducted a pre-test and post-test, comparing the two groups. The test questions were sourced from the school's standardized assessments, ensuring validity and reliability. Data obtained were analyzed and interpreted using IBM SPSS Statistics. The findings revealed a partial enhancement in CVC reading performance and a notable increase in students' interest and enthusiasm for phonics, particularly in the participants' positive attitudes. These improvements suggest a promising trajectory in the literacy development of young learners. Understanding which instructional method best supports foundational reading skills can provide valuable insights for educators and curriculum developers. This study is among the first to focus on early education, addressing a gap in research that predominantly targets older students. Nonetheless, it is essential to note that this study is limited to the K1 students enrolled in the research.

Keywords: *digital learners, English as a second language, instructional method, multimedia learning, reading comprehension*

Article History:

Received: October 1, 2024

Accepted: November 29, 2024

Revised: November 9, 2024

Published online: December 1, 2024

Suggested Citation:

Pesebre, R.D.P., Quicho, R.F., Collantes, L.M., Lamson, C.N. & Pentang, J.T. (2024). Effectiveness of multimedia tools in enhancing consonant-vowel-consonant reading performance and phonics interest and enthusiasm among kindergarten ESL students. *International Journal of Educational Management and Development Studies*, 5(4), 201-225. <https://doi.org/10.53378/ijemds.353131>

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1. Introduction

Multimedia tools are widely recognized in educational settings worldwide and are backed by numerous projects funded by various institutions (Norhayati & Hwa, 2004). Zhou and Yadav (2017) assert children's learning engagement increases through multimedia tools. These tools encompass diverse media elements like text, graphics, audio, video, and interactive features, aiming to deliver educational content effectively. Additionally, it must be implied that technology increases children's phonetical performance, including their ability to recognize consonant-vowel-consonant (CVC) words, which is crucial for early reading development. Focusing on the systematic relationship between written symbols and sounds, phonics instruction plays a vital role in early literacy (Li & Woore, 2021). Interactive whiteboards can significantly enhance ESL kindergarten students' engagement and motivation in phonics learning, suggesting a positive influence of multimedia tools on learning outcomes. The integration of multimedia tools has become increasingly prevalent (So et al., 2019; McCoy, 2014) and has extended to ESL instruction, where multimedia tools have shown promise in facilitating various aspects of language acquisition, as shown through the presence of multimedia tools in many classrooms. Various curriculums indicate a shift towards incorporating interactive or computer-aided instruction in educational settings, highlighting the need to address the diverse cognitive and linguistic processes contributing to reading competency. In contrast, traditional instructional methods often rely on teacher-led activities and lectures (Chen et al., 2023; Martirosov et al., 2023). Traditional tools, including printed materials, have historically been fundamental in education, particularly in teaching skills like CVC reading. However, their static nature lacks the dynamic engagement offered by multimedia resources. With technological advancements, teachers increasingly recognize the need to supplement traditional tools with multimedia to optimize learning outcomes. Undeterred by the arguments that preschoolers may be too young for multimedia exposure, the reality is that they are digital natives with technology at their disposal.

Despite the known advantages of multimedia tools in education, many educational institutions restrict their use due to concerns about technology overuse, eye strain, and a preference for traditional teaching methods (Lukman & Krajnc, 2012). This prohibition extends to nursery and K1 classes despite these students being considered digital natives (Carlotta et al., 2020). Not providing multimedia tools to preschoolers can be problematic because it may hinder their ability to develop essential digital literacy skills necessary for

success in today's technologically driven society. Early exposure to multimedia can help children become familiar with various digital platforms, tools, and interfaces, which are increasingly prevalent in educational and professional settings. Moreover, addressing global reading challenges remains a significant concern, with international assessments such as Progress in International Reading Literacy Study (PIRLS) and Programme for International Student Assessment (PISA) which measures students' ability to use reading, mathematics, and science knowledge and skills to meet real-life challenges but focusing solely on skills from the fourth grade onward. Traditional research in ESL learning typically overlooks preschool-aged students, including ELLs (Soltero-Gonzalez, 2009). The Early Grade Reading Assessment (EGRA) was developed to fill this gap, targeting grades one to three.

There remains a notable gap in understanding the comparative effectiveness of multimedia tools versus traditional instruction in early childhood education, particularly concerning preschool and kindergarten ESL students. Research has predominantly focused on primary and higher education levels, often leaving preschool education overlooked despite its critical role in foundational literacy development. This study addresses this gap by exploring the effectiveness of multimedia tools in enhancing CVC reading performance and fostering phonics interest and enthusiasm among kindergarten ESL learners. This research is socially relevant as it seeks to identify effective teaching strategies tailored to diverse learning styles in increasingly multicultural classrooms. The primary objectives are to evaluate how multimedia tools impact CVC reading performance, focusing on two key elements, letter-sound correspondence and sound-spelling dictation, and assess their influence on students' enthusiasm for phonics through crucial elements: active participation, task completion, attentiveness, positive attitude, and perseverance. By addressing these questions, the study aims to provide valuable insights that can inform educators and curriculum developers, ultimately creating more engaging and effective learning environments for young K1 ESL learners. This research serves as a leading initiative in this field.

2. Literature Review

2.1. Multimedia Tools

Adapting to the rapidly changing world is vital, especially in early education, as it equips students for future challenges. A mediated instructional approach involving collaboration between classroom teachers and media is increasingly recognized. Kurent and

Avsec (2023) highlight education's historical evolution, leading to integrating multimedia tools in teaching practices, particularly in language instruction such as phonics, and utilizing various media elements to enhance learning. Learners exposed to pictures and words achieve superior learning outcomes than those exposed to words alone. Digital resources enhance teaching strategies by facilitating diverse pedagogical methods. For example, they can be used for topic introduction through engaging multimedia presentations, for concept demonstration with interactive simulations, and for providing easy access to various texts. Additionally, these resources promote interactive engagement, allowing students to participate actively in their learning process.

2.2. CVC Reading

A solid grasp of phonics entails recognizing and applying letter sounds, including single-letter sounds, vowel combinations, consonant blends, and the CVC pattern. Geudens et al. (2004) found that VC patterns are more accessible for isolating phonemes than CV patterns. With CVC words, learners must identify individual sounds (phonemes) and match them with corresponding letters (graphemes) to spell words accurately. Contrarily, Bowers and Bowers (2017) argued for an instructional approach emphasizing the interconnectedness of morphology, etymology, and phonology rather than solely focusing on letter-sound correspondence. However, the study of Ningsih et al. (2023) suggested that learning CVC should be with picture media as it can increase the English vocabulary of the learners.

2.3. Interest and Enthusiasm

Interest and enthusiasm play crucial roles in phonics instruction, enhancing engagement and learning outcomes for young ESL students. When students show interest and enthusiasm in phonics, they are more likely to be attentive, participate actively, and retain the information they learn. Ciampa (2012) found positive effects of online eBooks on grade one students' reading motivation. Similarly, Yaftian and Barghamadi (2022) revealed significant effects of multimedia teaching on students' mathematical anxiety and motivation. Motivation ensures sustained effects and fosters students' creativity (Alhazbi & Hasan, 2021).

2.4. Literature Gaps

Enhancing young readers' skills relies on effectively blending CVC words, which is essential for fluency and accuracy. Multimedia tools can foster phonics interest, enthusiasm, and comprehension among preschoolers. While many studies focus on reading proficiency at higher levels, early reading stages, especially in preschool, are often overlooked. This study pioneers in assessing multimedia tools' effectiveness in improving literacy aspects like letter-sound correspondence, sound-spelling dictation, engagement, attentiveness, and positive attitude among young ESL learners in Shanghai, China.

3. Methodology

3.1. Theoretical Framework

The study was anchored on three main theoretical frameworks: Cognitive Load Theory (Sweller, 2019), Bottom-Up Model Cognitive Learning Theory (Moskovsky, 2015), and Social Cognitive Theory (Islam et al., 2023). Cognitive Load Theory, introduced by John Sweller, asserts that learning is impeded when tasks overwhelm working memory capacity. The Bottom-Up Model involves processing information from smaller to larger units. Multimedia learning theory emphasizes learners' processing capacity and prior knowledge, suggesting digital tools can aid learning due to the dual-channel hypothesis. Regarding interest and enthusiasm, the study is grounded in Social Cognitive Theory by Albert Bandura, which suggests learners acquire knowledge by observing and modeling others' behaviors.

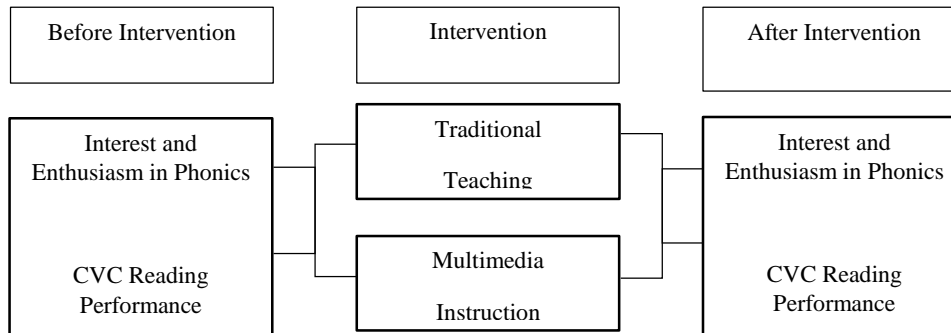
Building on these theoretical foundations, a total of eight-week intervention (two weeks of assessment and six weeks of experiment) was conducted for K1 students, who were divided into two groups based on their assigned classes upon enrollment: a traditional group with 14 participants and a multimedia group with 13 participants. The study utilized a pre-test and post-test to compare the outcomes of the two groups. This design aligns with the theories by allowing an exploration of how two different instructional methods can influence learning outcomes and engagement. All participants were between three and four-year-old students for whom English is not their mother tongue. Most students had previously attended a nursery class at the same school before entering K1.

Figure 1 presents the conceptual framework for the study, showing an interaction between the intervention and variables. Interest and enthusiasm in phonics and CVC reading performance were compared before and after the intervention. Besides, the interest and

enthusiasm in phonics and CVC reading performance of the group exposed to multimedia instruction were compared to those taught using traditional teaching. Meanwhile, the interest and enthusiasm in phonics of the group exposed to multimedia instruction were correlated to their CVC reading performance (after the intervention).

Figure 1

Conceptual framework of the study



3.2. Research Design

The study is quantitative and utilizes a quasi-experimental design, a type of empirical study that allows researchers to estimate the causal impact of an intervention on its target population without using randomization. The study utilized pre-test and post-test tests to assess multimedia instruction's effect on K1 participants' reading performance levels, interest, and enthusiasm.

3.3. Sample and Data Collection

Data were collected from 27 K1 students, divided into two groups based on their enrolment: a treatment group consisting of 14 students who received instruction using multimedia tools, and a control group of 13 students who were taught using traditional tools. The two classes at the school each enrolled 16 students. However, only 14 students from the multimedia-based treatment group and 13 students from the traditional instruction group consented to participate in the quasi-experimental research. The group assignments were based on the students' class enrolments and approved by the Academic Director of the school. K1 students, typically aged three to four, often had prior exposure to phonics in nursery classes before transitioning to K1. While both the nursery and K1 classes generally limited multimedia

tool usage, K1 students were deemed more appropriate for the study due to their age, academic readiness, and prior school experience, making them a better fit for the research than younger nursery students.

The study employed two sets of instruments to assess the students' CVC reading skills and their interest and enthusiasm in phonics. For reading performance, a pre-test was administered by the lead researcher, a K1 teacher, prior to the intervention. The same set of questions was used in a post-test administered six weeks later. Both the pre- and post-tests were aligned with the school's standardized tests, ensuring their relevance to the curriculum and enhancing their reliability and validity. The test items were adapted from lessons covering the letters M, S, P, and B, consisting of 15 items: seven focused on letter-sound identification (two for M, two for S, one for P, and two for B), where students were asked to read CVC words, identify the starting letter sound, and write the corresponding letter. Eight items focused on sound-spelling dictation, where the teacher read aloud CVC words, and students were required to spell the words. Each correct response earned one point. Both groups completed the assessments in a paper-and-pencil format under the supervision of the teacher/researcher.

For phonics interest and enthusiasm, the study used pre- and post-assessment tests based on the school's standardized Likert scale. Pre-test was administered by the teacher (the lead researcher) before the intervention and the post-test after the intervention. Five categories: active participation, task completion, attentiveness, positive attitude, and persistence, with responses rated on a 4-point Likert scale (4 = highest, 1 = lowest) were evaluated. The Likert scale assessment was administered by the lead researcher. This tool, being a standardized assessment of the school, contributed significantly to the credibility and validity of the study.

3.4. Data Analysis

The study employed statistical methods to draw interpretations and conclusions thoroughly. Descriptive statistics like mean and standard deviation, as well as inferential statistics such as dependent and independent samples and t-tests, were applied to analyze the CVC reading performance in terms of letter-sound correspondence and sound-spelling dictation and the interest and enthusiasm in phonics in terms of active participation, task completion, attentiveness, positive attitude, and persistence. The raw data were initially compiled using Microsoft Excel and then subjected to statistical analysis using IBM SPSS Statistics by a professional statistician.

3.5. Ethical Considerations

All necessary permissions for data collection were obtained from key administrative officials, including the School Principal and the Academic Director of Embrace K.I.D. Prior to participation, signed consent was obtained from the parents or guardians of the K1 students. A letter detailing the study's objectives and a consent form were sent to parents via both online (WeChat app) and written forms. The confidentiality of participants' identities and the security of the test data were assured, with all materials remaining in the possession of the researcher and the school. The intervention process and testing were clearly outlined to parents, emphasizing that only students with signed consent would participate. Parents were informed that they could withdraw their child from the study at any time without consequence. The protection of the students' well-being was prioritized throughout the research. Additionally, all research protocols were approved by the Ethics and Review Committee of Central Luzon State University.

4. Results and Discussion

4.1. CVC Reading Performance of the Participants

Table 1 presents the descriptive statistics of participants' CVC reading performance, categorized into traditional and multimedia groups.

Table 1

Descriptive Statistics of the Participants' CVC Reading Performance

Groups	CVC Reading Performance							
	Letter-Sound Correspondence				Sound-Spelling Dictation			
	Pretest		Posttest		Pretest		Posttest	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Traditional	5.45	2.26	7.00	0.00	3.08	3.07	3.45	3.45
Multimedia	6.79	0.80	6.43	1.02	4.71	3.22	6.50	2.24

Note: 0.00-5.99 (Unsatisfactory), 6.00-10.99 (Satisfactory), 11.00-15.00 (Very Satisfactory)

The multimedia group exhibited higher mean scores in pre-test and post-test tasks, with slight fluctuations in sound-spelling dictation scores from the pre-test (*Mean* = 4.71) to the post-test (*Mean* = 6.50). In contrast, in the traditional group, the mean scores for letter-sound correspondence increased from the pre-test (*Mean* = 5.45) to the post-test (*Mean* = 7.00),

indicating a notable improvement. Similarly, the mean scores for sound-spelling dictation tasks in the traditional group increased from 3.08 to 3.45, though the increase is less substantial than letter-sound correspondence.

The preference for multimedia tools in sound-spelling dictation tasks likely comes from multimedia materials' inherent engagement and interactivity. Multimedia tools often incorporate visually stimulating elements, like animations or interactive exercises, which can capture students' attention. This heightened engagement may lead to increased focus and retention. This is especially beneficial in tasks requiring auditory discrimination and phonemic awareness, such as sound-spelling dictation. On the other hand, the traditional instructional approach has a more positive effect on letter-sound correspondence tasks due to its structured and sequential presentation of phonics rules. It presents phonological principles systematically and sequentially and has a more favorable impact on this area. Breaking down phonics concepts into discrete components, and providing ample opportunities for practice and reinforcement, especially on the CVC word blending prove to be more advantageous. This structured approach facilitated a more methodical acquisition of letter-sound associations, improving letter-sound correspondence scores among students in the traditional group. This is also associated with the theoretical framework of a bottom-up approach. The letter-sound association was heightened because of the interaction between teacher and student as opposed to more reliance on multimedia. The observed preferences and performance outcomes in CVC reading tasks can be attributed to cognitive demands associated with each instructional modality. While students may prefer multimedia tools for sound-spelling dictation tasks due to their engaging and interactive nature, traditional instructional methods may confer advantages in tasks requiring systematic phonics instruction.

The study's findings contrast Ni et al. (2022), who found favorable outcomes with multimedia tools for Chinese English second language learners. However, some participants in this study struggled to concentrate on specific letter-sound correspondences due to sensory overload, which aligned with cognitive load theory. Lack of understanding regarding second language learners' utilization of multimedia-based language learning materials can lead to lost opportunity. Additionally, table 1 illustrates a notable increase in the traditional group's CVC reading performance regarding letter-sound correspondence, with mean scores rising from the pre-test ($Mean = 5.45, SD = 2.26$) to the post-test ($Mean = 7.00, SD = 0.00$). Similarly, the sound spelling dictation test indicated an increase in the traditional group's mean score from

3.08 to 3.45 post-test. This exemplifies the effectiveness of the traditional approach in enhancing participants' letter-sound correspondence skills. Skilled teachers adeptly employed traditional methods, offering tailored explanations and guidance, which, coupled with the tangible nature of traditional tools, appealed to students. This finding resonates with Mann and Foy's (2003) study involving 99 preschool children, which highlighted the significant correlation between phoneme awareness, traditional teaching methods, and early reading skills, emphasizing the intricate interplay between speech skills, letter-sound correspondence, and the development of early reading abilities.

4.2. Comparison between the Traditional and Multimedia Groups in their Post-CVC Reading Performance

Table 2

Comparative analysis of the post-test CVC reading performance of the participants between the traditional and multimedia groups

Groups	Post-test CVC Reading Performance							
	Letter-Sound Correspondence				Sound-Spelling Dictation			
	Mean	SD	t-value	p-value	Mean	SD	t-value	p-value
Traditional	5.46	2.26	-1.403	0.159	3.08	3.07	-3.327	0.003
Multimedia	6.43	1.02			6.50	2.24		

Note: *significant at .05 level

The two groups significantly differ in sound-spelling dictation scores (table 2). The multimedia group had a higher performance ($Mean = 6.50$) than the traditional group ($Mean = 3.08$), $t = 3.327$, $p < .01$. When the students in the multimedia group heard animated voices as played in the speaker from the computer during the sound-spelling dictation test, they showed more interest and listened fervently. Incorporating dynamic auditory stimuli, such as voice-over recordings, may have provided students with clear and accurate pronunciations of CVC words, enabling them to internalize phonetic patterns and apply them accurately during dictation tasks. The animated voices from the multimedia sparked the curiosity of the K1 students, enhancing their attention and leading to more positive outcomes. This approach provided a refreshing break from the teacher's voice. Additionally, interactive features such as animated phonics could have offered visual reinforcement of phonetic concepts, aiding

students in associating sounds with corresponding letters and improving spelling accuracy. Multimedia tools can provide more animation and clear pronunciation than audio-visual tools, and early learners enjoy it. As a result, the multimedia group got high results in the sound-spelling dictation. The result coincided with a study conducted among 933 Portuguese children (Maglhaes et al., 2020), specifically aimed to examine the association between misspellings in dictation. They found that misspellings were correlated with phonetics. For younger children, though, spelling mistakes were linked to text quality. Additionally, multimedia tools such as voice-over recordings and animated phonics can improve the students' sound spelling.

Multimedia's effect on letter-sound correspondence over the traditional tools did not make any significant mark ($p > .05$). The association of the sounds with the corresponding letters can be challenging for young learners. For example, /c/ and /g/ generally have the same sound. To associate the letters with their sound can be challenging. The use of multimedia tools failed to increase the letter-sound correspondence of the participants in the multimedia group. Understanding associations of the alphabet sounds was vital to make it easier to do the CVC blending. Despite the colorful animation of letters that could be presented in a PowerPoint presentation, it failed to increase this skill. Traditional tools, such as flashcards and labeled plastic cups used in the study, can do the task equally. Sigmundsson et al. (2017) affirmed that since letter-sound knowledge strongly influences reading development, it would also hold significance for overall academic achievement. This means that whether letter-sound knowledge had been taught in the traditional way or with the aid of multimedia tools, the impact of letter-sound knowledge was huge on the literacy level. Furthermore, in this study, one probable reason for not affecting the multimedia group was the relocation of the class to a multimedia-equipped classroom. Ensuring learners were settled, conditioned, and motivated before starting the phonics class. This underscores the significant impact a bottom-up approach could have on the lesson's outcome. In the multimedia group, though interactive, the absence of real-time feedback and personalized guidance may have hindered students' ability to identify and correct errors effectively during the dictation process.

4.3. Comparison between the Pre- and Post-CVC Reading Performance of the Multimedia Group

The multimedia group exhibited enhanced performance in sound-spelling dictation as the intervention progressed (table 3). The difference between the post-test ($Mean = 6.50$) was

significantly lower than the pre-test ($Mean = 4.71$), $t = -3.792$, $p < .01$. Providing individual tablets for writing answers during the task sparked excitement among the young learners, fostering a sense of ownership and personalization that contributed to improved outcomes. Particularly, K1 learners enjoyed using the tablet's erase button to correct mistakes, which, coupled with increased familiarity with the equipment over time, improved sound-spelling dictation skills for the multimedia group. The participants were more engaged because of their excitement about having their tablet, allowing them to manipulate it independently. They interacted better, which showed a better result than just using paper and pencil to answer the sound-spelling dictation.

Table 3

Comparative analysis between the pre-test and post-test CVC reading performance of the participants from the multimedia group

CVC Reading Performance	Test	Mean	SD	t-value	p-value
Letter-Sound Correspondence	Pre-test	6.79	0.80	1.794	0.096
	Post-test	6.43	1.02		
Sound-Spelling Dictation	Pre-test	4.71	3.22	-3.792	0.002
	Post-test	6.50	2.24		

Note: *significant at .05 level

The findings are confined to the twenty-seven ESL students participating in this two-month study. A more extended research period could have yielded deeper insights. However, the results suggest that the young learners demonstrated heightened interest and enthusiasm, especially when using their tables, which helped them better engage with the sound-spelling dictation provided by the teacher. This showed a promising effect in utilizing PowerPoint Presentations, audio effects, and other multimedia tools in the CVC reading performance of non-native speakers. Teaching CVC reading, particularly to ESL kindergarten students, could be challenging to novice educators. However, using multimedia tools, the students could be more engaged because of interactive and gamified learning experiences that visual and auditory representations of sounds and letters could provide.

Abraham (2007) observed that despite the wealth of multimedia-based language learning materials, there is limited understanding of how second language learners utilize these methods. He questioned whether sound-spelling dictation with multimedia tools truly benefits

second-language learners, emphasizing the ongoing uncertainty regarding its effectiveness, which contradicts the result of the study. Multimedia tools, known for their interactivity, make learning enjoyable and motivating, leading to better outcomes. Additionally, they provide multisensory experiences, aiding in effectively associating letter sounds with spellings but not necessarily on the sound-spelling dictation level. Spelling affects reading speed. Their findings revealed a strong association between spelling accuracy and reading speed among participants. Notably, the study outcomes provided direct evidence supporting the lexical quality hypothesis and emphasized the importance of spelling proficiency in developing literacy skills. The result mirrored the research conducted by Abdulrahman et al. (2020), which compiled a systematic review of multimedia tools in various fields' teaching and learning processes. This meant that equipping the classroom with multimedia tools and allowing the students to use them could positively affect their learning.

Multimedia tools failed to improve the letter-sound correspondence skills of the group ($p > .05$). The pre-test and post-test scores were relatively similar, showing no significant effect in this area. While multimedia presents teachers with significant opportunities to create meaningful and effective learning and teaching environments, it alone cannot guarantee success. Letter-sound correspondence is a tricky skill that young learners find challenging to learn. Some letters confuse young ESL learners in writing; examples are letters p, b, and d, which could be interchanged. This study used initial sounds for the letters M, S, P, and B. Even if the students know how to sound but may not know how to write the correct letter, it would be marked wrong. This skill is complex despite how animated the letters or sounds may be. At the K1 level, it is empirical for young students to learn about letter-sound correspondence (isolation) to get to the CVC reading stage. Letter sound correspondence skill refers to a reader's ability to associate specific sounds with corresponding letters or letter combinations. Recognizing letters and understanding their sounds are crucial aspects of early literacy instruction. These elements serve as foundational blocks in emergent literacy, as learning letters and their corresponding sounds helps children grasp the alphabetic principle, which enables them to spell and decode words (Manoharan, 2020). Using blocks of literacy models or phonics games could have given a better result. In this sense, multimedia tools failed to increase the letter-sound correspondence level of the multimedia group.

4.4. Interest and Enthusiasm in Phonics of the Participants

The interest and enthusiasm in phonics were categorized into five variables: active participation, task completion, attentiveness, positive attitude, and persistence. Among the five parameters, the positive attitude shows promising results in using multimedia tools (table 4). The pre-test scores of the traditional group ($Mean = 3.00$, $SD = 0.81$) and multimedia group ($Mean = 3.14$, $SD = 0.66$) and post-test scores of the traditional group ($Mean = 3.00$, $SD = 0.73$) and multimedia group ($Mean = 3.64$, $SD = 0.65$) illustrated the advantage of utilizing multimedia tools.

Table 4

Descriptive analysis of the interest and enthusiasm in phonics of the participants from the traditional and multimedia groups

Groups	Interest and Enthusiasm in Phonics	Pre-test		Post-test	
		Mean	SD	Mean	SD
Traditional	Active Participation	2.85	1.21	2.85	0.98
Multimedia		3.14	0.77	3.14	1.03
Traditional	Task Completion	3.00	1.22	3.08	0.34
Multimedia		3.36	0.75	3.50	0.76
Traditional	Attentiveness	2.77	1.09	3.15	0.30
Multimedia		3.43	0.65	3.43	0.65
Traditional	Positive Attitude	3.00	0.82	3.00	0.73
Multimedia		3.14	0.66	3.50	0.65
Traditional	Persistence	2.92	0.95	2.78	0.93
Multimedia		3.50	0.65	3.64	0.50

Note: 1.00-1.75 (Very Low Interest and Enthusiasm), 1.76-2.50 (Low Interest and Enthusiasm), 2.51-3.25 (High Interest and Enthusiasm), 3.26-4.00 (Very High Interest and Enthusiasm)

The increased familiarity and comfort with the task format over time contributed to the increased positive attitude of the multimedia group. The study findings indicate a significant improvement in the K1 students' positive attitude within the multimedia group, primarily attributed to their enhanced digital literacy skills developed through early exposure to technology. Integrating multimedia tools, including PowerPoint presentations, MP4 songs, tablets, and animations, tailored to diverse learning styles and preferences, facilitated a more enjoyable and engaging learning experience, fostering a positive perception of technology use. Introducing technology at an early age enhanced digital literacy skills. Honing the children's

phonics skills became more accessible because of their digital literacy. Moreover, the students in the multimedia group most likely found multimedia tools more enjoyable and engaging, leading to a more positive attitude. This positive attitude may have been influenced by increased confidence in their phonics skills, the contagious nature of positive attitudes among peers, and familiarity. The result echoes the findings of Chuan-Yu et al. (2022), who investigated different teaching methods involving online, traditional classrooms, and a blend of offline-online approaches. They found that online teaching led to higher student learning motivation than traditional methods, challenging conventional didactic teaching. Multimedia tools showed a particularly positive impact on student motivation compared to traditional instruction.

Moreover, table 4 revealed that in the active participation, the students in the traditional group may not have been stimulated by the repetitive teaching approach and phonics instruction in general. Traditional tools may lack the same level of excitement. Meanwhile, the multimedia group had a heavy reliance on multimedia tools, making it challenging to maintain the students' interest. The interaction between the teacher and the students suffered as a result. As the theoretical framework's bottom-up approach reflects, this was compared to developing one talent after another. Even when used for instructional purposes, excessive screen time may have negative impacts since it limits students' physical exercise and social connection. Both groups' instructional methods did not significantly affect task completion. Task completion required practice and reinforcement of phonics skills. The students might not have sufficient opportunities to apply their phonics knowledge to tasks. The study might not have been long enough to observe significant task changes. This was the first time the multimedia group was exposed to multimedia in a classroom. They had to move to a multimedia-equipped classroom, which made it challenging. Multimedia content, regardless of how simple it was designed for them, overwhelmed most preschoolers and led to cognitive overload, hampered their ability to process information and complete tasks. Exposing the students to a new environment leads to an overwhelming experience.

The same is true for their attentiveness and persistence. K1 students are developing persistence and problem-solving skills. Both methods did not allow trial-and-error learning, particularly in phonics lessons requiring precise answers. Short attention spans make the methods prone to boredom, often involving extended listening or sitting still periods. Preschoolers learn best through hands-on or sensory play interactive experiences, which

multimedia methods usually need to improve, leading to disengagement. Furthermore, multimedia tools cause sensory overload, inundating learners with visual and auditory stimuli and making it hard for them to focus on lessons. Distractions such as animations diverted attention from phonics. Moreover, young learners' naturally short attention spans compounded the challenge.

As for the persistence scores of both groups, the results show no significant difference in the pre-test and post-test. Some multimedia tools could have offered more immediate feedback, making staying motivated and persistent in the lesson challenging. On the other hand, traditional methods could have been more engaging for the students, leading to boredom and a lack of motivation to persist in the learning tasks. Moreover, traditional teaching, in this case, could have been more flexible because it strictly focused on predetermined learning objectives and timelines. This structure did not align with some students' pace and interest, leading to a lack of persistence. The results conformed with the work of Neo and Neo (2001). They believed that traditional educational approaches had resulted in a mismatch between what is taught to the students and what the industry needs.

4.5. Post-test Interest and Enthusiasm in Phonics of the Participants

Table 5

Comparative analysis of the participants' post-test interest and enthusiasm in phonics between the traditional and multimedia groups

Groups	Interest and Enthusiasm in Phonics	Mean	SD	t-value	p-value
Traditional	Active Participation	2.85	0.99	-0.764	0.452
Multimedia		3.14	1.03		
Traditional	Task Completion	3.08	0.95	-1.280	0.212
Multimedia		3.50	0.76		
Traditional	Attentiveness	3.15	0.80	-0.985	0.334
Multimedia		3.43	0.65		
Traditional	Positive Attitude	3.00	0.82	-1.767	0.090
Multimedia		3.50	0.65		
Traditional	Persistence	2.78	0.28	-3.084	0.005
Multimedia		3.64	0.13		

Note: *significant at .05 level

Table 5 shows several critical elements in both groups' interest and enthusiasm in phonics. The mean indicates the average persistence score, with the control group scoring 2.77 and the treatment group scoring 3.64, suggesting higher engagement in the latter. The SD, which measures the variation in scores, is 0.257 for the control group and 0.133 for the treatment group, reflecting greater consistency in the treatment group's scores. After the post-test, the persistence factor of the young learners displayed a significant difference ($t = -3.084$, $p < .01$). This implies that students in this group exhibited more uniform levels of persistence. The statistics illustrate the effectiveness of multimedia tools in fostering engagement and retention in learning phonics concepts. It suggests multimedia tools facilitated repeated exposure to phonics concepts engagingly, enhancing retention and persistence.

The visually engaging content made phonics more enjoyable, encouraging students to learn. Overall, multimedia tools' dynamic and engaging learning environment encouraged students to persist and actively participate in phonics learning. The students in the multimedia group who are considered digital natives displayed persistence when challenged in games. It is innate for young learners to be competitive. As manifested in the result, participants in the multimedia group showed their competitiveness positively. Hence, Wang and Lee (2021) posited that due to the advantages of multimedia, such as accessibility, integration of different media, and efficiency, several English teachers strive to develop several multimedia strategies to improve students' vocabulary learning and reading comprehension. In this sense, the learners' interest and enthusiasm deepened and, as a result, increased persistence.

On the other hand, the participants' active participation, task completion, and attentive and positive attitude from the traditional and multimedia groups did not show a significant difference ($p > .05$). Participants in both groups had similar baseline features, skills, and familiarity and stayed on even after the post-test. The learners' active involvement did not significantly increase. Reasons include the small sample size, short study duration, insensitive assessment tools, cultural preferences for traditional methods, and lack of multimedia tools in K1 classrooms. The diverse learning styles of the young learners might have allowed them to adapt to either teaching method. Many researchers have explored the incorporation of multimedia tools in various subjects like science (So et al., 2019), moral values education (Norhayati & Hwa, 2004), reading (Zhou & Yadav, 2017), mathematics (McCoy, 2014), and other areas. All displayed a positive effect of using multimedia tools, which the research study result does not conform with.

The presence of multimedia equipment and tools in a classroom does not necessarily equate to an increase in interest and enthusiasm of the learners. Although, as compared to traditional teaching methods, which often rely heavily on printed materials, multimedia tools can provide students with a more interactive and engaging learning experience. Videos can illustrate concepts and provide visual cues to aid comprehension. Audio recordings can also be used to improve pronunciation and listening skills. Interactive software, such as games and quizzes, can provide students immediate feedback and help reinforce their learning. In addition, multimedia tools can provide access to materials relevant to students' cultural backgrounds and interests, increasing their motivation to learn. However, Chu (2014) posited potential adverse effects of mobile learning on students' learning achievement and cognitive load, considering mobile learning as a multimedia tool. Additionally, Mehemet and Erdogan (2016) mentioned that using multimedia tools has more setbacks than gains. In addition, Martirosov et al. (2023) defined traditional education methods as teacher-centered and focused on explaining topics in a textbook using lectures or reading text. Their research revealed that students preferred traditional lectures and only performed better on the assessment with non-traditional podcast presentation styles. This approach emphasized the importance of interaction between teachers and students.

4.6. Interest and Enthusiasm in Phonics Pre-test and Post-test of Multimedia Group

The result in table 6 illustrated that before the intervention, the mean score for positive attitude was 3.14 in the multimedia group. After the intervention, the mean score significantly increased ($Mean = 3.50$), $t = -2.687$, $p < .05$. This revealed that implementing the multimedia treatment, which involved multimedia tools, considerably improved participants' positive attitudes. Multimedia resources like PowerPoint, mp4 songs, tablets, animations, and others catered to different learning styles and preferences, resulting in a positive attitude. Abdulrahman et al. (2020) compiled various studies and research to show the multimedia tools, technology, components, and applications for education. He also identified barriers to multimedia use in teaching and learning, such as attitudes and beliefs towards the use of technology in education, high resistance to change, lack of teachers' confidence in the use of technology, lack of basic knowledge and ICT skills for adoption and use of multimedia tools, lack of time to learn new technologies and many others. The digital learners in this group

demonstrated that multimedia tools could lead to a more positive attitude and increase their interest and enthusiasm in phonics.

Table 6

Comparative analysis between the pre-test and post-test interest and enthusiasm in phonics of the participants from the multimedia group

Interest and Enthusiasm in Phonics	Test	Mean	SD	t-value	p-value
Active Participation	Pre-test	3.14	0.77	0.000	1.000
	Post-test	3.14	1.03		
Task Completion	Pre-test	3.36	0.75	-1.000	0.336
	Post-test	3.50	0.76		
Attentiveness	Pre-test	3.43	0.65	0.000	1.000
	Post-test	3.43	0.65		
Positive Attitude	Pre-test	3.14	0.66	-2.68	0.019
	Post-test	3.50	0.65		
Persistence	Pre-test	3.50	0.65	-1.000	0.336
	Post-test	3.64	0.50		

Note: *significant at .05 level

On the other hand, statistical analysis revealed how the different variables, such as active participation, task completion, attentiveness, and persistence, did not incline to a more positive effect ($p > .05$). Both the t-value and p-value data for the pre-test and post-test of the K1 learners affirmed the findings. The intervention did not reap the benefit of multimedia tools, as illustrated in many studies (Mesfin et al., 2018; Sophonoihiranrak, 2021).

5. Conclusion

This study highlights the distinct effects of traditional and multimedia approaches on CVC reading performance and interest and enthusiasm in phonics in young learners. While multimedia tools showed initial advantages in sound-spelling dictation, their effectiveness on letter-sound correspondence was limited. The traditional methods, conversely, proved more beneficial in improving letter-sound recognition. The absence of multimedia tools indicates a missed opportunity to optimize early literacy development, as integrating technology can enhance engagement and persistence, particularly for ESL learners.

The findings advocate for incorporating multimedia resources in early education to bolster CVC reading performance and interest and enthusiasm in phonics. Given that preschool learners are digital natives, allowing them to engage with multimedia can significantly improve their literacy skills without undue health concerns. This study strongly recommends adopting multimedia tools to enhance reading outcomes in preschool settings. Nonetheless, this study strongly concludes the need to have a more unified approach, merging both multimedia tools with traditional instructions. A balanced method could more effectively meet the varied needs of learners. Future studies should investigate the long-term effects of these combined strategies to create more successful literacy subjects.

Following the study, these recommendations may enhance CVC reading performance and foster greater interest and enthusiasm for phonics among young learners.

Incorporate multimedia tools into teaching practices to enhance specific aspects of literacy learning. For example, utilizing sound spelling dictation tablets can reinforce phonetic awareness, while interactive games and videos can engage students and develop positive attitudes toward phonics. Additionally, integrating visuals, animations, auditory components, PowerPoints, and MP4s can cater to different learning styles, making literacy instruction more dynamic and effective. This approach supports cognitive engagement and helps create a more inclusive learning environment that fosters a love for reading and writing.

Complement multimedia tools with traditional teaching methods to ensure a well-rounded instructional approach that caters to all learners. Teachers can create a rich learning environment that addresses diverse needs by blending innovative digital resources with proven techniques, such as direct instruction, guided reading, and hands-on activities. This balance reinforces foundational skills while engaging students with interactive content, fostering a deeper understanding of literacy concepts.

Offer professional development opportunities for teachers focused on effectively utilizing multimedia tools, ensuring they are well-equipped to maximize the benefits of these resources. Training sessions could include workshops on selecting appropriate tools, integrating them into lesson plans, and assessing their impact on student learning. Schools can enhance the quality of literacy instruction by empowering teachers with the skills and confidence to use technology effectively.

Implement regular assessments or evaluations to monitor the effectiveness of multimedia tools in improving literacy skills, using this data to inform instructional decisions

and adjustments. These assessments can take various forms, such as formative assessments, student feedback, and performance metrics, enabling teachers to identify areas of success and areas needing improvement. Continuous evaluation ensures that instructional strategies remain responsive to student needs and supports improving literacy programs.

Tailor instruction to accommodate individual learning styles, recognizing that students may respond differently to multimedia resources and traditional methods. Teachers can engage students more effectively by offering a range of instructional strategies—such as differentiated tasks, personalized feedback, and varied content delivery. This customization boosts student motivation and promotes a deeper understanding of literacy skills, as learners can engage with materials in ways that resonate with them.

Allocate resources for technological improvements to support the effective use of multimedia tools in educational settings, ensuring all students have access to the necessary technology. This includes providing reliable internet access, maintaining up-to-date hardware and software, and creating flexible learning spaces conducive to collaborative and independent work. A robust technological foundation is essential for maximizing the potential of multimedia tools and fostering an equitable learning environment.

Initiate longitudinal studies to explore the long-term effects of multimedia-enhanced instruction on literacy development, providing valuable insights for future educational practices. By tracking student progress over time, researchers can identify trends, measure the impact of various instructional strategies, and assess the sustainability of literacy gains. These findings can guide educators in refining their approaches and contribute to the broader discourse on effective literacy instruction in the digital age.

By implementing these recommendations, teachers can effectively enhance literacy skills through digital and print resources, catering to diverse learning preferences and ensuring that all students benefit from interactive learning experiences. Research indicates that regular exposure to interactive materials improves literacy skills.

The study focused on the effects of multimedia tools on CVC reading competency and interest and enthusiasm in phonics among K1 ESL students. CVC reading competency was assessed according to letter-sound correspondence and sound-spelling dictation. Interest and enthusiasm in phonics were assessed through active participation, task completion, attentiveness, positive attitude, and persistence. The multimedia tools used were lecture videos, PowerPoint, photographs, e-flashcards, slides, song files, voice recordings, music videos, and

animations. The study was limited to the enrolled K1 students in the second semester of the academic year 2022 - 2023.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was not supported by any funding.

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References

- Abdulrahman, M.D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fagm, A. O., & Azeez, A. L. (2020). Multimedia tools in teaching and learning processes: A systematic review. *Heliyon*, 6(11), e05312. <https://doi.org/10.1016/j.heliyon.2020.e05312>
- Alhazbi, S., & Hasan, M. A. (2021). The role of self-regulation in remote emergency learning: comparing synchronous and asynchronous online learning. *Sustainability*, 13(19), 11070. <https://doi.org/10.3390/su131911070>
- Bowers, J., & Bowers, P. (2017). Beyond phonics: The case for teaching children the logic of the English spelling system. *Educational Psychologist*, 52(2), 124-141. <https://doi.org/10.1080/00461520.2017.1288571>
- Carlotta, C., Carmen, D., Simone, R., Maurizio, S., & Silvia, C. (2020). Smartphone-based answering to school subject questions alters gait in young digital natives. *Frontiers in Public Health*, 8, 187. <https://doi.org/10.3389/fpubh.2020.00187>
- Chen, H., Wen, Y., & Jin, J. (2023). Computer-aided teaching and learning of basic elementary functions. *Heliyon*, 9(5), e15987. <https://doi.org/10.1016/j.heliyon.2023.e15987>

- Chu, H.-C. (2014). Potential negative effects of mobile learning on students' learning achievement and cognitive load—A format assessment Perspective. *Journal of Educational Technology & Society*, 17(1), 332-344. <http://www.jstor.org/stable/jeductechsoci.17.1.332>
- Chuan-Yu, M., Jiyang, J., & Peiqi, J. (2022). Relationship between teachers' teaching modes and students' temperament and learning motivation in Confucian culture during the COVID-19 pandemic. *Frontiers in Psychology*, 13, Article 865445. <https://doi.org/10.3389/fpsyg.2022.865445>
- Ciampa, K. (2012). Electronic storybooks: A constructivist approach to improving reading motivation in grade 1 students. *Canadian Journal of Education / Revue Canadienne de l'éducation*, 35(4), 92-136. <http://www.jstor.org/stable/canajeducrevucan.35.4.92>
- Geudens, A., Sandra, D., Broeck, W. (2004). Segmenting two-phoneme syllables: Developmental differences in relation with early reading skills. *Brain and Language*, 90(1-3), 338-352. [https://doi.org/10.1016/S0093-934X\(03\)00446-2](https://doi.org/10.1016/S0093-934X(03)00446-2)
- Islam, K. F., Awal, A., Mazumder, H., Munni, U. R., Majumder, K., Afroz, K., Tabassum, M. N., & Hossain, M. (2023). Social cognitive theory-based health promotion in primary care practice: A scoping review. *Heliyon*, 9(4). <https://doi.org/10.1016/j.heliyon.2023.e14889>
- Kurent, B., & Avsec, S. (2023). Examining pre-service teachers' regulation in distance and traditional preschool design and technology education. *Heliyon*, 9, e13738. <https://doi.org/10.1016/j.heliyon.2023.e13738>
- Li, S., & Woore, R. (2021). The effects of phonics instruction on L2 phonological decoding and vocabulary learning: An experimental study of Chinese EFL learners, *System*, 103, Article 102677. <https://doi.org/10.1016/j.system.2021.102677>
- Lukman, R., & Krajnc, M. (2012). Exploring non-traditional learning methods in virtual and real-world environments. *Journal of Educational Technology & Society*, 15(1), 237-247. <http://www.jstor.org/stable/jeductechsoci.15.1.237>
- Magalhaes, S., Mesquita, A., Filipe, M., Veloso, A., Castro, S. L., & Limpo, T. (2020). Spelling performance of Portuguese children: Comparison between grade level, misspelling type, and assessment task. *Frontiers in Psychology*, 11, 547. <https://doi.org/10.3389/fpsyg.2020.00547>

- Mann, V. A., & Foy, J. G. (2003). Phonological awareness, speech development, and letter knowledge in preschool children. *Annals of Dyslexia*, 53(1), 149-173. <http://www.jstor.org/stable/23764738>
- Manohan, Arya & Jose, Jubil & Saji, Sneha. (2022). Teaching Alphabet Recognition and Letter Sound Correspondence Using a 4 Blocks of Literacy Model for Children with Complex Communication Needs (CCN): Illustrated with a Single Case Study. *International Journal of Health Sciences and Research*. 12. 99-104. <https://doi.org/10.52403/ijhsr.20220114>
- Martirosov, A.L., Alex, J., Doane, A., Pater, R., Aprilliano, B., & Kale-Pradhan, P. (2023). Podcasts and videos and slides...oh my!: Traditional vs. non-traditional teaching methods in remote settings. *Currents in Pharmacy Teaching and Learning*, 15(6), 587-592. <https://doi.org/10.1016/j.cptl.2023.06.007>
- McCoy, L. (2014). Web 2.0 in the Mathematics Classroom. *Mathematics Teaching in the Middle School*, 20(4), 237-242. <https://doi.org/10.5951/mathteacmiddscho.20.4.0237>
- Mesfin, G., Ghinea, G., Grønli, T.-M., & Hwang, W.-Y. (2018). Enhanced agility of e-learning adoption in high schools. *Journal of Educational Technology & Society*, 21(4), 157-170. <http://www.jstor.org/stable/26511546>
- Moskovsky, C., Jiang, G., Libert, A., & Fagan, S. (2015). Bottom-up or top-down: English as a foreign language vocabulary instruction for Chinese University students. *TESOL Quarterly*, 49(2), 256-277. <http://www.jstor.org/stable/43893753>
- Mukti, N., & Hwa, S. P. (2004). Malaysian perspective: Designing interactive multimedia learning environment for moral values education. *Journal of Educational Technology & Society*, 7(4), 143-152. <http://www.jstor.org/stable/jeductechsoci.7.4.143>
- Neo, M., & Neo, K. (2001). Innovative teaching: Using multimedia in a problem-based learning environment. *Journal of Educational Technology & Society*, 4(4), 19-31. <http://www.jstor.org/stable/jeductechsoci.4.4.19>
- Ni, A., Cheung, A., & Shi, J. (2022). Effects of educational technology on reading achievement for Chinese K-12 English second language learners: A meta-analysis. *Frontiers in Psychology*, 13, 102576. <https://doi.org/10.3389/fpsyg.2022.1025761>
- Ningsih, Wirda & Akhyar, Yundri & Puspita, Yenda (2023). Using CVC (Consonant Vowel Consonant) with picture media in teaching vocabulary for the young learner. *Jurnal Ilmu Pendidikan*. 1.1-19.

- Ozerbas, M. A., & Erdogan, B. H. (2016). The effect of the digital classroom on academic success and online technologies self-efficacy. *Journal of Educational Technology & Society*, 19(4), 203-212. <http://www.jstor.org/stable/jeductechsoci.19.4.203>
- Sigmundsson, H., Eriksen, A., Ofteland, G. S., & Haga, M. (2017). Letter-sound knowledge: Exploring gender differences in children when they start school regarding knowledge of large letters, small letters, sound large letters, and sound small letters. *Frontiers in Psychology*, 8, 1539. <https://doi.org/10.3389/fpsyg.2017.01539>
- So, W. W. M., Chen, Y., & Wan, Z. H. (2019). Multimedia e-learning and self-regulated science learning: A study of primary school learners' experiences and perceptions. *Journal of Science Education and Technology*, 28(5), 508-522. <https://www.jstor.org/stable/48699328>
- Soltero-González, L. (2009). Preschool Latino immigrant children: Using the home language as a resource for literacy learning. *Theory Into Practice*, 48(4), 283-289. <http://www.jstor.org/stable/40344656>
- Sophonhiranrak, S. (2021). Feature, barriers and influencing factors of mobile learning in higher education: A systematic review. *Heliyon*, 7(4), e06696. <https://doi.org/10.1016/j.heliyon.2021.e06696>
- Sweller, J., van Merriënboer, J. J. G., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review*, 31, 216-292. <https://doi.org/10.1007/s10648-019-09465-5>
- Wang, S., & Lee, C.I. (2021). Multimedia gloss presentation: Learners' preference and the effects on EFL vocabulary learning and reading comprehension. *Frontiers in Psychology*, 11, 602520. <https://doi.org/10.3389/fpsyg.2020.602520>
- Yaftian, N., & Barghamadi, S. (2022). The effect of teaching using multimedia on mathematical anxiety and motivation. *Journal of Research and Advances in Mathematics Education*, 7(2), 55-63. <https://doi.org/10.23917/jramathedu.v7i2.16141>
- Zhou, N., & Yadav, A. (2017). Effects of multimedia story reading and questioning on preschoolers' vocabulary learning, story comprehension and reading engagement. *Educational Technology Research and Development*, 65(6), 1523-1545. <http://www.jstor.org/stable/45018616>