EDUCARE Journal of Primary Education
ISSN 2716-1021 (p) 2716-1013 (e)
OPEN ACCESS
https://educare.uinkhas.ac.id/index.php/jie
DOI: 10.35719/educare.v5i2.306
Vol 5, No 2, December 2024, pp. 175-192

Improving Elementary School Students' Science Literacy through Office Sway Interactive Learning Media

Dewi Sulastri[1*], Encep Andriana[2], A. Syachruroji[3]
[1,2 &3] Elementary School Teacher Education, Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, Indonesia

Article Information:
Received 2024-10-12
Revised 2024-11-28
Accepted 2024-12-27

Keywords:
Instructional Media, Office Sway, Science Literacy

ABSTRACT

This study addresses the need to improve science literacy among elementary school students. Although traditional teaching methods are important, they sometimes fail to fully engage students or deepen their understanding of the material. Therefore, this study explores the potential of using Office Sway as an interactive learning media to enhance science literacy. The aim of this study is to assess the effectiveness of using Office Sway in supporting the improvement of science literacy among elementary school students. This study also seeks to understand how Office Sway can enhance student engagement and deepen their understanding of scientific concepts through interactive multimedia elements. The results of the study show that Office Sway has significant potential to increase student engagement and science literacy in elementary schools by presenting content in a more dynamic and engaging way through interactive multimedia features. However, the success of using Office Sway heavily depends on several factors, such as well-structured teacher training, supportive technological infrastructure, and continuous content updates. To maximize its effectiveness in learning, a holistic approach and continuous evaluation are necessary. This study provides important contributions by identifying the potential of Office Sway as a learning tool that can enhance student engagement and understanding of scientific concepts, while also highlighting the importance of teacher training, proper infrastructure, and ongoing evaluation.

INTRODUCTION

In education, the selection of learning media plays a crucial role in helping students understand the material and strengthening the teacher's delivery (Chang et al., 2020; Liu, 2024). Alalwan (2022) and Harefa et al. (2023) emphasized that effective media increases student engagement and understanding. However, using traditional media such as whiteboards is often less engaging and interactive, which can reduce student engagement (Lee et al., 2022). Students' misunderstandings about the material are usually caused by inadequate reference materials, a challenge that must be addressed to improve science literacy (Darling-Hammond et al., 2019; Doshi et al., 2024). Mulder et al (2023) suggested that developing science education materials for the web is essential in addressing this problem. According to Rosenthal (2020) and Holincheck et al (2022), computer-based media and regular internet access can improve science literacy. Levrini et al. (2019) and Hamaker et al (2020), also stated that in-depth scientific understanding requires media to convey temporal patterns and causal explanation models effectively. Therefore, educational institutions must implement modern and interactive learning media to help students build connections between scientific concepts and real-world problems while improving their scientific literacy.

Based on the current literature review, several studies have been conducted on developing Office Sway media in various learning contexts. First, research by Kim et al., (2022) and Sunarti et al (2023) shows that this media is practical and feasible for learning reading comprehension in elementary school with non-fiction text material, recorded with a percentage of material expertise of

To cite this article (APA Style):
Sulastri, D., Andriana, E., & Syachruroji, A. (2024). Improving Elementary School Students' Science Literacy through Office Sway Interactive Learning Media. *EDUCARE: Journal of Primary Education, 5(2)*, 175-192. https://doi.org/10.35719/educare.v5i2.306

***Corresponding Author**: Dewi Sulastri, Elementary School Teacher Education Study Program, Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, Indonesia, email: 2227200018@untirta.ac.id

90 and a median of 88.6. Second, research by Dayu et al. (2024) found that Office Sway effectively teaches poetry writing skills at the same level, showing a high level of validity, practicality, and effectiveness. Third, according to Markamah (2022), using Sway-based media for fine arts lessons in elementary schools has increased student learning motivation and learning outcomes. Fourth, research by Sujanem & Suwindra (2023) indicates that interactive physics modules assisted by Microsoft Sway successfully improve students' critical thinking skills. However, current research focuses more on using Office Sway to improve the scientific literacy skills of grade IV students in the material style of science lessons. In contrast to previous studies that focused more on improving specific skills such as writing, reading, critical thinking, and art, this study aims to explore the potential of Office Sway in advancing science literacy, demonstrating different purposes in its use.

This study aims to develop interactive learning media using Office Sway, focusing on improving students' scientific literacy. The main objectives of this study are to evaluate the media development process, collect feedback from students, and validate the media quality through expert assessments. This learning media is expected to improve elementary school student's understanding of the concept of force in Natural and Social Sciences material as an essential part of scientific literacy. Students can more easily access scientific data by utilizing the hyperlink feature that can be shared in Office Sway presentations. This strategy is designed to overcome obstacles that often occur in science learning and open up opportunities for innovation in this field. With the integration of this technology, students will gain broader and more relevant insights into technological advances and the needs of the current digital era. This learning media is also expected to increase interest in learning, motivate students, and positively impact their mental health.

In this study, the hypothesis proposed is that using interactive learning media, Office Sway will improve elementary school student's understanding of the concept of force in Natural and Social Sciences material compared to conventional learning methods. In addition, it is also hypothesized that the use of Office Sway will increase students' interest in learning IPAS material. Furthermore, it is expected that integrating hyperlinks in Office Sway presentations will make it easier for students to access scientific information, which will support the improvement of their scientific literacy. An additional hypothesis proposes that this interactive learning media will positively impact students' learning motivation and mental health. These hypotheses will be tested through an experimental research design using pre-tests and post-tests to measure changes in students' understanding, interest, and motivation before and after the implementation of Office Sway as a learning tool.

RESEARCH METHOD

This research was conducted in elementary schools in Tangerang Regency using the Research and Development (R&D) approach. According to Tetteh (2024), R&D aims to produce innovation or enhance the quality of existing products to make them more ideal. In the context of education, Brame (2016) emphasized that R&D is a crucial strategy for creating effective educational media, such as Office Sway. In this study, the development of digital media based on Office Sway was carried out continuously for improvement and refinement. The main goal was to increase the effectiveness of the educational process in the future and achieve optimal results in the upcoming school year. Thus, through the R&D approach, it is hoped that better and more relevant educational media will be created to meet current educational needs.

This study applies the APPED development model, which consists of five stages: Initial Analysis and Research, Design, Production, Evaluation, and Dissemination (Banyen et al., 2016; Wahjono et al., 2021), to test its effectiveness in creating interactive multimedia technology-based learning products. In the Initial Analysis and Research stage, a needs analysis was conducted to consider student characteristics and the latest technology. The Design stage involves creating storyboards and visual designs. In the Production stage, the product is developed according to the predetermined design. Product evaluation is carried out through trials involving experts in materials, media, language, and users to ensure its quality (Zafar et al., 2014; Vallee et al., 2020). After the

evaluation stage, the final product will be distributed. The Dissemination stage focuses on introducing the product to the public and highlighting the expected benefits of using the media.

The data for this study were collected from various sources, including expert evaluations, interviews, tests, and questionnaires completed by both students and teachers. According to Tetteh (2024), assessments such as these are essential in gathering a comprehensive understanding of the subject. The test itself consisted of 15 questions, with 10 focused on general knowledge and five on essay-style responses. Brame (2016) emphasized that using different questions in the pre-test and post-test, while still referencing the same indicators of scientific literacy, allows for a more effective assessment of the participants' progress. This approach ensures that the evaluation process accurately measures the intended learning outcomes. The following data management technique formula is used to analyze the expert validation test questionnaire with the formula: NP = $\frac{R}{SM}$ x 100%

The Likert scale, commonly used to assess the attitudes and opinions of individuals or groups, was employed in expert assessment tests to evaluate the feasibility of the evaluation and determine category scores. According to Heo et al. (2022), the Likert scale provides a reliable method for measuring subjective responses, allowing for clear categorization of evaluations. Similarly, da Cunha et al. (2022) highlighted its usefulness in determining the effectiveness of an evaluation by translating expert opinions into quantifiable scores, ensuring a more structured and objective assessment process. Each of the five dimensions that make up the Likert scale is described as follows:

Table 1. Description of Likert Scale

Scale	Description
5	Very Poor
4	Poor
3	Quite Good
2	Good
1	Very Good

Based on Table 1, this Likert Scale starts from "1," which means "Very Good," indicating the highest level of satisfaction, to "5," which means "Very Poor," indicating significant dissatisfaction. The number "2" marks "Good," which still allows for improvement, while "3," or "Quite Good," indicates an average standard. "4" or "Poor" means a deficiency. This scale makes it easy to categorize and analyze various views or levels of respondent satisfaction with a topic.

The students' science literacy skills test scores were measured using data collected from two test sessions. The first test was conducted before the students used the Sway media, and the second was conducted after using the press. Then, the scores from the pre-test and post-test that had been assessed were converted into numeric values using the following equation:

$$\text{Mark} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100\%$$

This formula is used to calculate the results of the student questionnaire response assessment, expressed as NP = n/N x 100% (Wu et al., 2022). According to Wu et al. (2022), this method provides a straightforward way to quantify responses and assess the overall performance. The student survey employs a Yes/No scale, also known as the Guttman scale, which is a common approach for evaluating binary responses. Guttman's method, as noted by Wu et al. (2022), simplifies the process of analyzing responses, allowing for clear, concise assessment results based on student feedback.

RESULTS AND DISCUSSION

Results

Steps to Develop Office Sway Interactive Learning Media

In the development stage of learning media using Office Sway for this study, researchers conducted a series of structured activities to ensure the effectiveness of the media in the educational context. The process began with analyzing school conditions to identify specific student needs and existing learning conditions. Furthermore, the media design stage was carried out to develop a design

based on the results of the analysis. Media production was then carried out, followed by an evaluation to test the feasibility and effectiveness of the media in an authentic learning environment. The final stage is dissemination, where the learning media that has been developed is disseminated to more classes and schools for broader use. Each of these stages is crucial to ensure that the learning media developed is innovative, relevant, and beneficial to the student learning process.

Table 2. Media Development Steps

No	Activities	Description
1	Analysis of Needs, Curriculum, Media and Characteristics of Students	Most students have mobile phones but are less interested in science lessons because the complex material and monotonous teaching methods such as lectures, discussions, and questions and answers make them bored quickly. Although the Independent Curriculum aims for more active and independent learning, its practice is still too teacher-centered, resulting in minimal independent learning activities from students. In addition, the use of traditional learning media and the rare integration of technology, such as interactive software, which is limited by teacher time, are also obstacles. Students' diverse characteristics and tendency to get bored quickly indicate the need for a more innovative learning approach to increase interest in learning.
2	Design of Office Sway Learning Media	In the design stage of this interactive learning media, researchers prepare a detailed outline, adjusting the style topic according to students' learning objectives and needs. The outline includes the primary material and sub-materials, with real examples to facilitate understanding. The media design integrates various components, such as images, videos, audio, and text, with learning resources coming from books, YouTube, and other internet. For navigation in Office Sway, the flowchart guides users by clicking links that lead to media through various pages such as home, media information, materials, learning videos, quizzes, singing, evaluations, bibliographies, and developer profiles.
3	Production of Office Sway Interactive Learning Media	In the production stage, researchers develop media prototypes using various digital tools. Images and videos are created using Canva, while instrumental music is taken from SoundCloud. Interactive quizzes are created through Wizer.me, and evaluations are done using Microsoft Forms. In addition, research instruments such as validation sheets, tests, and questionnaires have also been prepared. This media is designed to increase student engagement by integrating text, images, animation, and video in an interactive display.
4	Evaluation of Office Sway Learning Media	The evaluation of interactive learning media shows its effectiveness, with smooth functionality, customized and error-free materials, and visual displays that support an optimal learning experience.
5	Dissemination	This dissemination was carried out to class teachers. It was held more widely at SDIT Tunas Muda Unggul on September 20, 2024, aiming to reach schools lacking information about learning media, with further details on the provided link.

The Office Sway learning media development process includes several critical stages. Starting from needs analysis, it was found that monotonous curriculum and complex materials made students less engaged. Moving on to design, where media is tailored to students' needs through interactive materials and intuitive navigation. In the production stage, digital tools such as Canva and SoundCloud are used to create engaging content, which is tested through evaluation to ensure the functionality and relevance of the material. The final stage, dissemination, focuses on expanding the use of this media at SDIT Tunas Muda Unggul to increase access to innovative learning. Each step is designed to maximize student engagement and learning effectiveness.

Office Sway Media Feasibility Test in Learning for Students

The feasibility of using Office Sway as a learning media for students can be evaluated based on the results of a validity test conducted by a team of material experts, media experts, and language experts. The research team gathered scores from each group of experts, assessing various aspects of the media's effectiveness in supporting student learning. Material experts evaluated the content's accuracy and relevance, while media experts focused on its technical aspects and user interface. Language experts reviewed the clarity and coherence of the language used in the media. These expert evaluations provided valuable insights into the suitability and potential of Office Sway as an effective educational tool for students.

Table 3. Average Results of Expert Validation Assessment

Validator Expert	Percentage	Category
Media	85%	Very Eligible
Material	95%	Very Eligible
Language	78,88%	Eligible
Average Score	86,29%	Very Eligible

The table above presents the results of the expert assessment, based on the average percentage from each validation test assessor. The findings indicate that the three validations conducted fall within the "very feasible" category. This suggests that the development of interactive Office Sway learning media has met the standards set by experts, confirming its effectiveness and quality. The assessment results demonstrate that the media is well-received and deemed suitable for educational purposes, supporting its potential for use in enhancing the learning process. Thus, it reflects a high level of approval from the validation experts.

Results of Students' Science Literacy Skills after Using Office Sway Media

During the trial, students were very enthusiastic, although many had difficulty understanding and answering long questions in the pre-test. The pre-test consisted of ten multiple-choice questions and five essays that had been validated and revised based on expert input. An explanation of using the media was given before the learning process, and a post-test was provided with different questions after the activity was completed. Initially, students felt anxious during the pre-test but became calmer and more understanding when working on the post-test after the learning process. The table below shows the average results of the pre-test and post-test for each indicator:

Table 4. Average Results of Pre-test and Post-test Per Indicator

No.	Indicators Science Literacy	Percentage (%)	
		Pre-test	Post-test
1.		50,2%	84%
2.	Remembering and applying appropriate scientific knowledge.	48%	77%
3.	Identifying, using, and producing transparent and representative models.	39,3%	84,5%
4.	Explaining the potential implications of scientific knowledge for society.	25%	75%
5.	Proposing ways to explore given questions scientifically.	4,2%	91%
6.	Transforming and changing data from one representation to another.	25%	89%
7.	Making and justifying appropriate predictions.	84%	66%

Judging from the seven indicators of scientific literacy containing 30 questions, namely 15 pre-test questions and 15 post-test questions, in the pre-test questions, six indicators fall into the inferior category, and one indicator falls into the good category, while in the post-test questions, four indicators fall into the good category, two indicators are excellent and one indicator falls into the sufficient category, with an average pre-test of 40.04% "Very Poor" and post-test 76.37% "Good".

The results of the N-Gain calculation after collecting pre-test and post-test data. The results of the N-Gain analysis show that students' scientific literacy increased after following instructions with Office Sway. The table below shows the N-Gain results:

Tabel 5. Average of Pre-test and Post-test

Information	*Pre-test*	*Post-test*
Highest Score	64	96
Lowest Score	4	52
Amount	1.280	2.444
Average	40,04	76,37
Average N-Gain	0,59	
Category	Currently	

The pre-test and post-test results showed an increase in students' scientific literacy. In the pre-test, the highest score was 64, and the lowest was 4, with 29 students in the inferior category, one less, and two sufficient. In the post-test, the highest score reached 96, and the lowest was 52, with one student being impoverished, two low, nine good, 14 very good, and six very good. Improvements occurred in three students at the low level, seventeen at the medium level, and twelve at the high level. The average increase in scientific literacy scored 0.59 in the medium category. Although some students still gave careless answers and had difficulty understanding essential points, using Office Sway learning media helped improve students' scientific literacy skills through more complex thinking processes, such as analysis, creativity, and critical thinking, which go beyond simply relying on memory.

Student Responses to Office Sway Interactive Learning Media

The Office Sway interactive learning media was tested in a limited trial to assess student responses. During the trial, a questionnaire covering three key aspects was distributed to the students. A total of 32 students participated in filling out the questionnaire, providing valuable feedback on their experiences with the media. This trial aimed to gather insights on the effectiveness and engagement of the Office Sway learning tool, based on students' direct responses and evaluations. The feedback from the students will be used to refine and improve the media for future use. The students' responses can be seen in the following table:

Table 6. Average Student Response Score

Aspects	Percentage	Category
Media display	97,91%	Very Eligible
Media content	89,06%	Very Eligible
Material presentation	100%	Very Eligible
Language	100%	Very Eligible
Average	96,74%	Very Eligible

The results for the media display aspect were 97.91%, for media content 89.06%, for material presentation 100%, and for language 100%, based on students' responses to the interactive learning media Office Sway. Overall, the four aspects combined achieved an impressive 96.74%, placing them in the "Very Good" category. Despite this high rating, the Office Sway media received a 3.26% score for shortcomings, with the most notable issue being that not all students were able to use their email addresses to access the quiz section. This limitation affected the full accessibility of the media. Nevertheless, Elementary School students gave the Office Sway learning media product a "Very Good" rating after evaluating its content, specifically the material on the styles around us. The positive response highlights the effectiveness of the media in delivering educational content and engaging students in the learning process.

Discussion

Implementation of Office Sway Interactive Learning Media Based on School Needs

According to Budiarto and Jazuli (2021), as well as Matteson and Grant (2024), Office Sway represents a promising advancement in interactive learning media, particularly for use in elementary education. These scholars argue that compared to conventional tools like Microsoft PowerPoint, Office Sway offers a more dynamic and immersive learning environmentc (Zhao & Ko, 2022; Petruse et al., 2024). By enabling the integration of multimedia elements such as videos, 3D visuals, and interactive quizzes, Office Sway supports a richer and more engaging presentation of educational content (Abrori, et al., 2023). This interactivity, they suggest, plays a critical role in enhancing students' comprehension of complex topics. Moreover, the emphasis on student involvement aligns with contemporary pedagogical views that recognize active participation as a fundamental factor in effective learning outcomes (Lei, 2023). Thus, using tools like Office Sway may significantly boost the quality of classroom instruction by fostering deeper engagement and understanding among young learners.

The Research and Development (R&D) approach used in developing Office Sway-based content enables the media to be continually tailored to the specific needs of both students and teachers. According to Sjolie & Ostern (2020) and Goldshaft et al. (2022), incorporating direct feedback from users allows for the content to be more closely aligned with the learning requirements of elementary school students. This approach ensures that learning materials can be adjusted to accommodate various student learning styles, whether visual, auditory, or kinesthetic, thereby enhancing the effectiveness and relevance of the educational experience (Menon et al., 2023).

Implementing Office Sway at the elementary school level presents several challenges, including the need for teachers to become proficient with the technology and the limitations in technological infrastructure in some schools. Darling-Hammond (2017) and Daza et al. (2021) highlight that reliance on technology can pose significant challenges, particularly if technical issues arise. Without proper training and resources, the full potential of technology-based learning may not be realized. To address these challenges, it is essential to provide teachers with technical training and ensure that schools have access to the necessary devices and stable internet connections. Such support is crucial to ensure the smooth integration of Office Sway and similar technologies into the classroom, enhancing the overall learning experience (Qushem et al., 2021; Ojong, 2023).

The implementation of Office Sway, which is tailored to the needs of elementary school students, involves using the APPED Model, which includes the stages of analysis, design, production, evaluation, and dissemination. The analysis stage helps understand students' learning needs. In contrast, the design to evaluation stage ensures that the content developed is not only relevant but also easily accessible and enjoyable for students (Chun Tie et al., 2019; Strojny et al., 2023). With an inclusive and adaptive approach, Office Sway can be a learning tool that enriches students' learning experiences through multimedia integration, encourages active engagement, and significantly improves student learning outcomes. With this method, Office Sway functions as a presentation tool and a medium that can present interactive, relevant, and appropriate learning for students' learning needs in the 21st century.

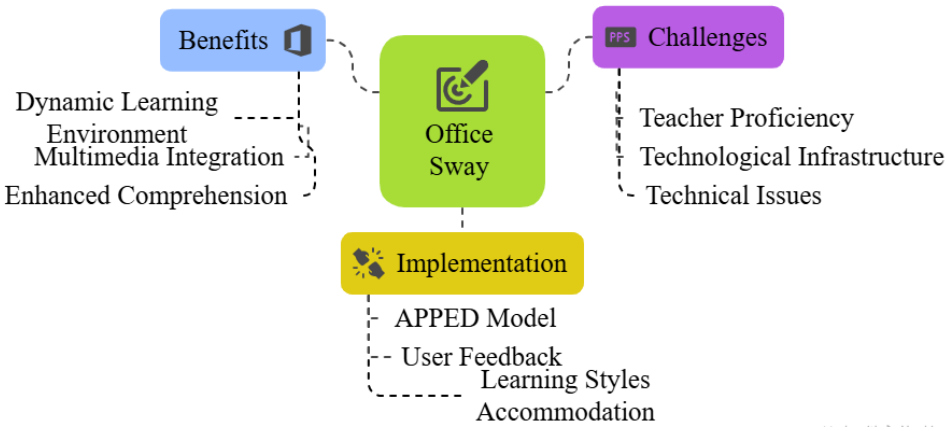

Figure 1. Office Sway: Benefits, Challenges, and Implementation

In conclusion, the successful implementation of Office Sway in elementary schools depends on several key approaches. First, it is essential to provide teachers with proper training and resources, enabling them to effectively utilize Office Sway in their teaching practices. Second, integrating Office Sway into the curriculum should be done strategically, ensuring it is not viewed as a supplementary tool but as an integral part of existing teaching methods. Finally, ongoing evaluation of Office Sway is necessary to measure its influence on student learning outcomes and identify areas for improvement. By focusing on these strategies, schools can ensure that Office Sway becomes a valuable resource, enhancing the learning experience and supporting better educational outcomes for students. These efforts will maximize the potential of technology in the classroom and foster a more engaging and effective learning environment.

Optimizing Office Sway: Interactive Learning Media for Elementary Schools

Karolcik et al. (2015) and Rice & Ortiz (2021) emphasize that Office Sway holds significant promise as an interactive learning medium, particularly in the context of elementary education. Under the theme "Optimizing Office Sway: Interactive Learning Media for Elementary Schools," validation results demonstrate strong support for its educational application, with experts awarding it an overall feasibility score of 86.29%. This high rating reflects Sway's effectiveness in delivering engaging and varied content, accommodating multiple learning styles, and offering flexible teaching solutions tailored to diverse student needs. El-Sabagh (2021) and Al Shloul et al. (2024) also argue that Office Sway is more than a digital tool—it represents a modern, adaptable educational platform that responds to the evolving demands of 21st-century classrooms. Its dynamic features enable educators to optimize their instructional strategies, making learning more interactive and student-centered.

According to Rice and Ortiz (2021), the effective use of Office Sway in elementary education depends greatly on two foundational components: well-structured teacher training and the availability of sufficient technological resources. They argue that without these supports, the integration of digital learning platforms like Office Sway is likely to face considerable challenges, especially in terms of technical execution. Teacher training plays a pivotal role in equipping educators with the necessary skills to maximize the features of Sway, while reliable access to digital devices and internet connectivity enables seamless usage in the classroom (Badawy et al., 2024). These conditions are essential for transforming Sway into a tool that truly enhances learning and encourages greater student interaction. Therefore, as Budiarto and Jazuli (2021) also suggest, optimizing the implementation of such tools involves not only adopting new media but also ensuring the learning environment is equipped to support it effectively.

Carlos (2024) and Kurniawan et al. (2024) acknowledge that Office Sway stands out for its strong technical and visual presentation capabilities, with expert assessments placing its effectiveness between 83.15% and 87.36%. These scores affirm its potential as a powerful medium for delivering educational content that is both engaging and technically sound. However, as Voogt et al. (2016) emphasize, the rapid evolution of the educational environment demands that digital content be regularly updated to keep pace with curriculum developments and emerging pedagogical trends. Grimus (2020) also stresses the importance of collaboration between educators and content developers to ensure that instructional materials not only meet academic standards but are also captivating and effective for learners. This ongoing partnership ensures that tools like Office Sway remain relevant and impactful in fostering dynamic and meaningful learning experiences in today's classrooms.

According to Viberg et al. (2020) and Grassini (2023), Office Sway has received outstanding validation scores between 92.5% and 97.5%, indicating its strong capacity to fulfill educational standards and enhance instructional quality. These high evaluations reflect the platform's ability to deliver engaging and pedagogically effective content. Nonetheless, to sustain such effectiveness, continuous refinement is essential. As Grassini (2023) suggests, incorporating user feedback plays a crucial role in adapting materials to remain aligned with learners' evolving needs. Viberg et al. (2020) also emphasize the importance of iterative development in digital learning tools to ensure they keep pace with dynamic educational objectives. This cyclical process of evaluation and enhancement enables Office Sway to maintain its relevance and effectiveness, ultimately supporting its role as a powerful medium for transformative learning experiences in the classroom.

Mondal et al. (2022) and Tlili et al. (2024) assert that adopting an iterative approach in developing digital educational content allows for continuous refinement, ensuring it remains responsive to diverse learning styles and evolving pedagogical practices. In the context of Office Sway, this process also highlights the importance of linguistic validation. The variation in expert evaluations—ranging from 68.88% to 88.88%—underscores the critical need to balance linguistic precision with effective communication. Tlili et al. (2024) emphasize that for educational materials to be effective, especially for elementary school learners, they must be clear, engaging, and easily digestible. Mondal et al. (2022) further argue that ambiguity in language can hinder comprehension

and reduce the instructional value of digital tools. Therefore, combining clear language with interactive content ensures that students not only understand but also enjoy the learning process, enhancing their overall engagement and academic success.

Quadir et al. (2020) and Liu et al. (2023) highlight that implementing Office Sway in elementary schools has successfully enhanced student interaction and engagement, as demonstrated in a case study involving 32 learners. The use of this digital tool not only supported students' mastery of the subject matter but also enriched their overall learning experience. However, Martinez-Pelaez et al. (2023) caution that sustained effectiveness requires ongoing evaluation and the incorporation of feedback from both educators and students. Zhou et al. (2024) further emphasize that for technology like Office Sway to be fully optimized, there must be a harmonious integration of technological resources, well-structured teacher training, and the development of content aligned with current curriculum demands. When these elements work together, Office Sway evolves into more than just a visually engaging platform—it becomes a dynamic, effective, and inclusive educational tool capable of meeting the diverse needs of modern classrooms (Tlili et al., 2021).

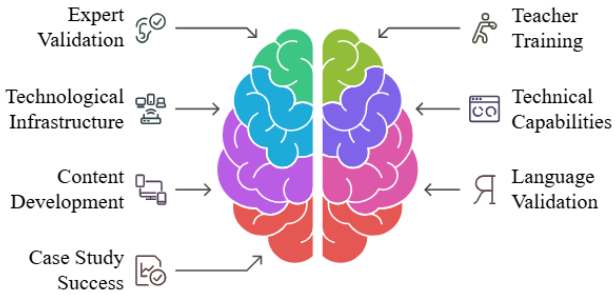

Figure 2. Optimizing Office Sway in Education

According to Merino et al. (2024) and Xue et al. (2024), although Office Sway has demonstrated strong potential as an interactive learning tool—evidenced by high validation scores and positive outcomes in elementary classrooms—its effective implementation demands a more comprehensive and context-sensitive strategy. While factors such as teacher training and technological infrastructure are vital, they alone are insufficient. Broader systemic issues like curriculum coherence, teacher workload, and digital literacy disparities among both educators and learners must also be addressed. Moreover, despite high evaluations in technical and content presentation, inconsistencies in linguistic validation scores point to challenges in ensuring clarity and inclusivity for all students (Davies & West, 2014; Cosby, et al., 2023). The iterative nature of content development is encouraging, yet it calls for sustained collaboration among educators, content developers, and education policymakers. Although case studies show promise, concerns remain regarding the tool's scalability and adaptability across diverse educational settings. Thus, optimizing Office Sway involves not only technological improvements but also integrated educational strategies and ongoing institutional support to promote equitable and effective learning.

The Influence of Learning Media on Students' Mastery of Science Literacy

As highlighted by Hsiao et al. (2019) and Azevedo (2020), the integration of Office Sway as an interactive learning medium in elementary schools has shown a significant impact on improving students' science literacy. This is reflected in the increase in students' average scores from 40.04% on the pre-test to 76.37% on the post-test, using assessment instruments validated by subject matter experts. These instruments measure key competencies such as explanation, analysis, and evaluation, indicating that Office Sway effectively supports the development of scientific understanding. However, while these results suggest a clear enhancement in students' mastery of scientific concepts, the long-term influence of such media on students' sustained motivation and interest in science remains uncertain. As noted by Friman et al. (2019), Lee et al. (2024), and Bareis et al. (2024), further investigation is needed to determine whether the increased engagement observed through this media has lasting effects on students' enthusiasm and curiosity in science learning.

Gan et al. (2015) and Gaceri et al. (2022) argue that the integration of digital tools like Office Sway with interactive learning methods is essential to optimize their impact on student learning. Rather than functioning as a standalone medium, Office Sway becomes more effective when embedded within comprehensive instructional strategies such as project-based learning, inquiry-based activities, or collaborative group discussions. These approaches not only enhance students' grasp of scientific concepts but also increase their engagement and participation in the learning process. According to these scholars, the synergy between interactive technology and student-centered pedagogy fosters deeper conceptual understanding and critical thinking. Therefore, Office Sway should be viewed not merely as a platform for content delivery, but as a catalyst for active learning and meaningful collaboration in the classroom (Vallée et al., 2020). This blended model of instruction helps create dynamic educational environments that support both cognitive and social dimensions of learning.

Further evaluation is necessary to understand which specific aspects of science literacy are enhanced by using Office Sway, including critical thinking, comprehension of science concepts, and the application of knowledge in real-world contexts (Tulchinsky & Varavikova, 2014; Feijoo et al., 2023). To ensure that this technology remains effective and adaptable, educators must develop flexible implementation strategies. This includes regular updates to materials, continuous teacher training, and monitoring the impact of technology on learning outcomes (Haleem et al., 2022; Hennessy et al., 2022). These actions will ensure that Office Sway continues to significantly contribute to enhancing students' science literacy while addressing the evolving demands of digital-era education. Although Office Sway has been effective at Sarakan III Elementary School, there are ongoing challenges, particularly regarding students' reading skills and material comprehension. Nor & Mahmud (2024) emphasized that some aspects of science literacy have yet to be fully addressed, underscoring the need for a more holistic, systematic approach. While students' positive feedback suggests that Office Sway fosters engagement and independent learning (Liu et al., 2024), other critical factors also affect its overall effectiveness.

The successful use of interactive learning technologies like Office Sway is heavily reliant on stable internet access, as it is essential for maximizing the tool's potential. Taye (2023) and Contrino et al. (2024) emphasize the importance of continuously adapting to student feedback and addressing specific learning needs to ensure that learning media are fully utilized to meet educational goals (Tang, 2022). While Office Sway shows promise as an innovative tool, its long-term success hinges on effective management of technology infrastructure and an ongoing commitment to improvement. This includes regular evaluation and development based on real-world feedback and the evolving needs of students and educators (Jiang & Kurnitski, 2023; Al Kez et al., 2024). Without these strategic efforts, the tool's potential might not be fully realized, highlighting the importance of combining technological resources with thoughtful implementation and continuous refinement to achieve optimal learning outcomes.

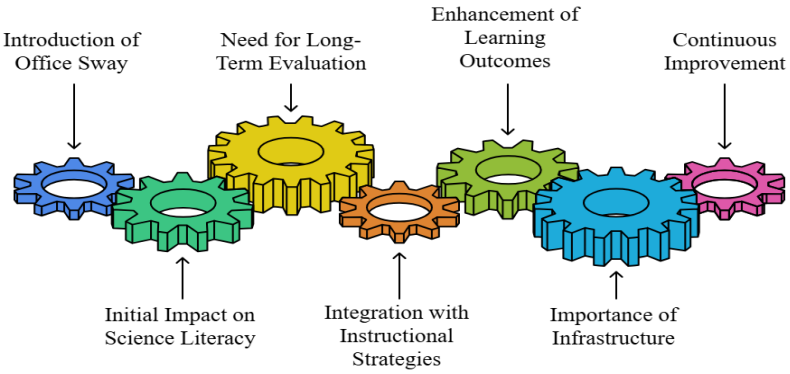

Figure 3. Integrating Office Sway in Science Education

Office Sway presents a unique platform that integrates visual, audio, and interactive elements to boost student engagement and understanding. The inclusion of icons, such as the idea light for

creativity, multimedia icons for audio and video, and group icons for collaboration, emphasizes its potential to offer a dynamic and engaging learning experience. Additionally, its adaptive learning capabilities, represented by icons for books and statistics, support personalized teaching approaches that cater to the diverse needs of students (Gligorea et al., 2023; Harris et al., 2023). However, while these features showcase the platform's promise, challenges remain in its implementation. Effective use of Office Sway requires teacher proficiency in creating and delivering interactive content, which may be hindered by teachers' existing workloads and varied digital literacy levels. Furthermore, the need for reliable internet access and adequate devices could lead to accessibility issues, particularly in schools with limited resources (Taye, 2023; Contrino et al., 2024).

In conclusion, while Office Sway holds significant potential as an innovative tool for enhancing science literacy in elementary schools, its success relies on a multi-faceted approach. Real-time evaluation through interactive quizzes and projects is valuable, but its effectiveness is contingent on well-designed assessment tools aligned with learning objectives. The success of collaborative learning and critical thinking activities also depends on how effectively teachers can integrate them within a structured curriculum. To maximize Office Sway's impact, consistent professional development for educators, investments in technology infrastructure, and continuous content updates based on student feedback and curricular needs are essential. Without addressing these core elements, the tool may not reach its full potential, limiting its effectiveness in improving student learning outcomes. Therefore, a comprehensive and systematic effort is necessary to ensure the successful integration of Office Sway within the educational ecosystem.

CONCLUSION

In conclusion, Office Sway holds significant potential as an interactive learning tool that can enhance student engagement and science literacy in elementary schools. Its multimedia capabilities, such as integrating videos, 3D visuals, and interactive quizzes, provide a dynamic learning experience. However, successful implementation requires well-structured teacher training, reliable technological infrastructure, and ongoing content updates to meet the evolving needs of students and educators. The tool's effectiveness is also contingent on addressing challenges like digital literacy disparities and access to resources. By adopting a holistic approach, including continuous evaluation and adaptation based on feedback, Office Sway can serve as a powerful platform for fostering active learning and improving student outcomes. Ensuring these elements are in place will maximize its potential, making it a valuable asset in modern educational settings.

The theoretical implication of using Office Sway in education lies in the importance of integrating interactive media to support active learning and constructivism theories, which emphasize student involvement in the learning process. Office Sway can enrich this approach by providing a more immersive and adaptive learning experience. Practically, teachers need adequate training to fully utilize Office Sway's features, as well as ensuring that schools have the necessary technological support. Additionally, regular evaluations of its usage are essential to ensure alignment with curriculum needs and technological developments. With the right approach, Office Sway can significantly enhance the quality of learning in elementary schools.

For future research, it is recommended to explore the long-term impact of Office Sway on student motivation and engagement in science education, particularly in diverse educational settings. Studies could examine how different student demographics, such as those with varying levels of digital literacy, respond to the platform's interactive features. Additionally, further research should focus on the development of effective teacher training models that ensure educators can fully leverage Office Sway's capabilities. Investigating the scalability of this tool across different schools and regions with varying technological resources would also be valuable. Lastly, continuous user feedback should be incorporated into content development to ensure the tool remains relevant and effective in meeting evolving educational needs.

ACKNOWLEDGEMENT

The researcher would like to express his deepest gratitude to all parties at Elementary School, Sepatan District, Tangerang Regency, and Sultan Ageng Tirtayasa University for the support, assistance, and facilities provided during the research process. Thanks also to the editors and all parties of the Educare journal for all their valuable suggestions and for the opportunity and support in publishing the results of this study. Close cooperation and invaluable assistance from all institutions have enabled the researcher to complete this research successfully.

BIBLIOGRAPHY

Abdallah, A. K., Kaabi, A. M. A., & Ramadan, R. S. (2023). The Critical Role Of Principals In Leading Effective Inclusive Schools. In Inclusive Phygital Learning Approaches And Strategies For Students With Special Needs (pp. 256-281). *IGI Global*. https://doi.org/10.4018/978-1-6684-8504-0.ch012

Abrori, F. M., Prodromou, T., Alagic, M., Livits, R., Kasti, H., Lavicza, Z., & Anđić, B. (2023). Integrating mathematics and science to explain socioscientific issues in educational comics for elementary school students. *Journal of Graphic Novels and Comics*, 15(4), 508–524. https://doi.org/10.1080/21504857.2023.2292734

Al Kez, D., Lowans, C., & Foley, A. (2024). Sustainable Development in Third Level Programs: Distilling a Pathway to a True Net-Zero Education. *Sustainability, 16(5)*, 1998. https://doi.org/10.3390/su16051998

Al Shloul, T., Mazhar, T., Abbas, Q., Iqbal, M., Ghadi, Y. Y., Shahzad, T., Mallek, F., & Hamam, H. (2024). Role Of Activity-Based Learning And Chatgpt On Students' Performance In Education. *Computers and Education: Artificial Intelligence, 6*, Article 100219. https://doi.org/10.1016/j.caeai.2024.100219

Alalwan N. (2022). Actual Use Of Social Media For Engagement To Enhance Students' Learning. *Education and information technologies, 27(7)*, 9767–9789. https://doi.org/10.1007/s10639-022-11014-7

Azevedo, J. (2020). Teaching Media Literacy Through Scientific Controversies. *In The Handbook of Media Education Research* (eds D. Frau-Meigs, S. Kotilainen, M. Pathak-Shelat, M. Hoechsmann and S.R. Poyntz). https://doi.org/10.1002/9781119166900.ch18

Badawy, H. R., Al Ali, F. M., Khan, A. G., Dashti, S. H., & Al Katheeri, S. A. (2024). *Transforming Education Through Technology and School Leadership*. In A. Abdallah, A. Alkaabi, & R. Al-Riyami (Eds.), Cutting-Edge Innovations in Teaching, Leadership, Technology, and Assessment (pp. 182-194). *IGI Global Scientific Publishing*. https://doi.org/10.4018/979-8-3693-0880-6.ch013

Banyen, W., Viriyavejakul, C., & Ratanaolarn, T. (2016). A Blended Learning Model for Learning Achievement Enhancement of Thai Undergraduate Students. *International Journal of Emerging Technologies in Learning (iJET), 11(04*), pp. 48–55. https://doi.org/10.3991/ijet.v11i04.5325

Bareis, A., Spengler, M., Rieger, S., Gladstone, J. R., Yang, J. S., Nagengast, B., Trautwein, U., & Wigfield, A. (2024). Examining The Conscientiousness × Interest Compensation (CONIC) Model With Similar Constructs In High School And College Students. *Journal of Research in Personality, 110*, 104462. https://doi.org/10.1016/j.jrp.2024.104462

Brame C. J. (2016). Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content. *CBE life sciences education, 15(4)*, es6. https://doi.org/10.1187/cbe.16-03-0125

Budiarto, F., & Jazuli, A. (2021). Interactive Learning Multimedia Improving Learning Motivation Elementary School Students. *ICONESS*, EAI. https://doi.org/10.4108/eai.19-7-2021.2312497

Carlos, J. (2024). Impact Of Digital Learning Tools On Student Engagement In High School Classrooms In Peru. *American Journal of Education and Practice, 8(4)*, 25–35. https://doi.org/10.47672/ajep.2246

Chang, Y. -S., Chen, C. -N., & Liao, C. -L. (2020). Enhancing English-Learning Performance through a Simulation Classroom for EFL Students Using Augmented Reality—A Junior High School Case Study. *Applied Sciences, 10(21)*, 7854. https://doi.org/10.3390/app10217854

Chun Tie, Y., Birks, M., & Francis, K. (2019). Grounded Theory Research: A Design Framework For Novice Researchers. *SAGE Open Medicine, 7*. https://doi.org/10.1177/2050312118822927

Contrino, M. F., Reyes-Millán, M., & Vázquez-Villegas, P. (2024). Using An Adaptive Learning Tool To Improve Student Performance And Satisfaction In Online And Face-To-Face Education For A More Personalized Approach. *Smart Learning Environments, 11(1)*, Article 6. https://doi.org/10.1186/s40561-024-00292-y

Cosby, A., Fogarty, E. S., & Manning, J. (2023). Digital Literacy and Digital Self-Efficacy of Australian Technology Teachers. *Education Sciences, 13(5)*, 530. https://doi.org/10.3390/educsci13050530

da Cunha, R. A., Rangel, L. A. D., Rudolf, C. A., & dos Santos, L. (2022). A Decision Support Approach Employing The PROMETHEE Method And Risk Factors For Critical Supply Assessment In Large-Scale Projects. *Operations Research Perspectives, 9*, Article 100238. https://doi.org/10.1016/j.orp.2022.100238

Darling-Hammond, L. (2017). Teacher Education Around The World: What Can We Learn From International Practice? *European Journal of Teacher Education, 40(3)*, 291–309. https://doi.org/10.1080/02619768.2017.1315399

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2019). Implications For Educational Practice Of The Science Of Learning And Development. *Applied Developmental Science, 24(2)*, 97–140. https://doi.org/10.1080/10888691.2018.1537791

Davies, R.S., & West, R.E. (2014). *Technology Integration in Schools*. In: Spector, J., Merrill, M., Elen, J., Bishop, M. (eds) Handbook of Research on Educational Communications and Technology. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-3185-5_68

Dayu, D. P. K., Nafisah, D., & Cindy, A. H. (2024). Microsoft Sway Media for Students' Independent Learning in The Independent Curriculum Era. *Journal of Learning and Technology, 3(1)*, 10–18. https://doi.org/10.33830/jlt.v3i1.9730

Daza, V., Gudmundsdottir, G. B., & Lund, A. (2021). Partnerships As Third Spaces For Professional Practice In Initial Teacher Education: A Scoping Review. *Teaching and Teacher Education, 102*, Article 103338. https://doi.org/10.1016/j.tate.2021.103338

Doshi, A., Weinert, S., & Attig, M. (2024). Self-Regulatory Abilities As Predictors Of Scientific Literacy Among Children In Preschool And Primary School Years. *Learning and Individual Differences, 114*, 102515. https://doi.org/10.1016/j.lindif.2024.102515

El-Sabagh, H. A. (2021). Adaptive E-Learning Environment Based On Learning Styles And Its Impact On Development Students' Engagement. *International Journal of Educational Technology in Higher Education, 18(1)*, Article 53. https://doi.org/10.1186/s41239-021-00289-4

Feijoo, B., Zozaya, L., & Sádaba, C. (2023). Do I Question What Influencers Sell Me? Integration Of Critical Thinking In The Advertising Literacy Of Spanish Adolescents. *Humanities and Social Sciences Communications, 10(363)*. https://doi.org/10.1057/s41599-023-01872-y

Friman, M., Maier, R., & Olsson, L. E. (2019). Applying A Motivational Stage-Based Approach In Order To Study A Temporary Free Public Transport Intervention. *Transport Policy, 81*, 173-183. https://doi.org/10.1016/j.tranpol.2019.06.012

Gaceri, M., Njina, A., & Kang'aru, E. (2022). Incorporating Social-Media to Enhance Collaboration in Online Learning. *Journal of Computer Science and Technology Studies, 4(1)*, 35-40. https://doi.org/10.32996/jcsts.2022.4.1.3

Gan, B., Menkhoff, T., & Smith, R. (2015). Enhancing Students' Learning Process Through Interactive Digital Media: New Opportunities For Collaborative Learning. *Computers in Human Behavior, 51(Part B)*, 652-663. https://doi.org/10.1016/j.chb.2014.12.048

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. -T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review. *Education Sciences, 13(12)*, 1216. https://doi.org/10.3390/educsci13121216

Goldshaft, B., Sjølie, E., & Johannesen, M. (2022). Student Teachers' Research And Development (R&D) Practice - Constraining And Supporting Practice Architectures. *Pedagogy, Culture & Society, 32(3)*, 853–873. https://doi.org/10.1080/14681366.2022.2140698

Grassini, S. (2023). Shaping the Future of Education: Exploring the Potential and Consequences of AI and ChatGPT in Educational Settings. *Education Sciences, 13(7)*, 692. https://doi.org/10.3390/educsci13070692

Grimus, M. (2020). Emerging Technologies: Impacting Learning, Pedagogy and Curriculum Development. In: Yu, S., Ally, M., Tsinakos, A. (eds) Emerging Technologies and Pedagogies in the Curriculum. Bridging Human and Machine: Future Education with Intelligence. *Springer*, Singapore. https://doi.org/10.1007/978-981-15-0618-5_8

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding The Role Of Digital Technologies In Education: A Review. *Sustainable Operations and Computers, 3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hamaker, E. L., Mulder, J. D., & van IJzendoorn, M. H. (2020). Description, Prediction And Causation: Methodological Challenges Of Studying Child And Adolescent Development. *Developmental Cognitive Neuroscience, 46*, 100867. https://doi.org/10.1016/j.dcn.2020.100867

Harefa, E. P., Waruwu, D. P., Hulu, A. H., & Bawamenewi, A. (2023). Pengembangan Media Pembelajaran Bahasa Indonesia Berbasis Website dengan Menggunakan Model ADDIE. *Journal on Education, 6*(1), 4405-4410. https://doi.org/10.31004/joe.v6i1.3581

Harris, D., Coleman, K., & Cook, P. J. (2023). Radical Rubrics: Implementing The Critical And Creative Thinking General Capability Through An Ecological Approach. *Australian Educational Researcher, 50(3)*, 729–745. https://doi.org/10.1007/s13384-022-00521-8

Hennessy, S., D'Angelo, S., McIntyre, N., Koomar, S., Kreimeia, A., Cao, L., Brugha, M., & Zubairi, A. (2022). Technology Use For Teacher Professional Development In Low- And Middle-Income Countries: A Systematic Review. *Computers and Education Open, 3*, 100080. https://doi.org/10.1016/j.caeo.2022.100080

Heo, C. Y., Kim, B., Park, K., & Back, R. M. (2022). A Comparison Of Best-Worst Scaling And Likert Scale Methods On Peer-To-Peer Accommodation Attributes. *Journal of Business Research, 148*, 368-377. https://doi.org/10.1016/j.jbusres.2022.04.064

Holincheck, N., Galanti, T. M., & Trefil, J. (2022). Assessing the Development of Digital Scientific Literacy With a Computational Evidence-Based Reasoning Tool. *Journal of Educational Computing Research, 60(7)*, 1796-1817. https://doi.org/10.1177/07356331221081484

Hsiao, H.-S., Chen, J.-C., Lin, C.-Y., Zhuo, P.-W., & Lin, K.-Y. (2019). Using 3D Printing Technology With Experiential Learning Strategies To Improve Preengineering Students' Comprehension Of Abstract Scientific Concepts And Hands-On Ability. *Journal of Computer Assisted Learning, 35(2)*, 178-187. https://doi.org/10.1111/jcal.12319

Jiang, Q., & Kurnitski, J. (2023). Performance Based Core Sustainability Metrics For University Campuses Developing Towards Climate Neutrality: A Robust PICSOU Framework. *Sustainable Cities and Society, 97*, 104723. https://doi.org/10.1016/j.scs.2023.104723

Karolcik, S., Cipkova, E., Hrusecky, R., & Veselsky, M. (2015). The Comprehensive Evaluation Of Electronic Learning Tools And Educational Software (CEELTES). *Informatics in Education, 14(2)*, 243-264. https://doi.org/10.15388/infedu.2015.14

Kim, H., O'Sullivan, D. M., & Chung, S. H. (2022). Applying Gamification Principles And Therapeutic Movement Sequences To Design An Interactive Physical Activity Game: Development Study. *JMIR Serious Games, 10(4)*, e38133. https://doi.org/10.2196/38133

Kurniawan, D., Masitoh, S., Bachri, B. S., wahyuningsih, T., Mulawarman, W. gede., & Vebibina, A. (2024). Evaluation of Digital Project Based Blended Learning Model to Improve Students' Critical Thinking and Problem Solving Skills. *Journal of Ecohumanism, 3(8)*, 1875–1895. https://doi.org/10.62754/joe.v3i8.4847

Lee, H. J., Park, Y., & Bong, M. (2024). Differences In The Longitudinal Relationship Between Self-Efficacy And Interest Across Domains And Student Characteristics. *Learning and Individual Differences, 113*, 102462. https://doi.org/10.1016/j.lindif.2024.102462

Lee, J., Choi, H., Davis, R. O., & Henning, M. A. (2022). Instructional media selection principles for online medical education and emerging models for the new normal. Medical Teacher, 45(6), 633–641. https://doi.org/10.1080/0142159X.2022.2151884

Lei, G. (2023). Influence of ASSURE Model In Enhancing Educational Technology. *Interactive Learning Environments, 32(7)*, 3297–3313. https://doi.org/10.1080/10494820.2023.2172047

Levrini, O., Tasquier, G., Branchetti, L., & Barelli, E. (2019). Developing future-scaffolding skills through science education. International Journal of Science Education, 41(18), 2647–2674. https://doi.org/10.1080/09500693.2019.1693080

Liu, C.-H., Horng, J.-S., Chou, S.-F., Yu, T.-Y., Huang, Y.-C., Ng, Y.-L., & La, Q. P. (2024). Explore Links Among Marketing Knowledge, Data Literacy, Skill Improvement, And Learning Attitude In STEAM Application For Hospitality And Tourism Education. *The International Journal of Management Education, 22(1)*, 100919. https://doi.org/10.1016/j.ijme.2023.100919

Liu, Q. (2024). Strategy Transformation of Teachers as Facilitators in English Classrooms. *Journal of Educational Research and Policies, 6(10)*, 56–59. https://doi.org/10.53469/jerp.2024.06(10).15

Liu, Y., Zhan, Q., & Zhao, W. (2023). A Systematic Review of VR/AR Applications In Vocational Education: Models, Affects, And Performances. *Interactive Learning Environments*, 1–18. https://doi.org/10.1080/10494820.2023.2263043

Markamah, M., & Nugraheni, E. P. (2022). Pengembangan Media Pembelajaran Berbasis Microsoft Sway Mupel Seni Rupa Materi Menggambar Ilustrasi Di Sekolah Dasar. *Jurnal Sitakara, 7*(1), 64-72. https://doi.org/10.31851/sitakara.v7i1.7468

Martinez-Pelaez, R., Ochoa-Brust, A., Rivera, S., Felix, V. G., Ostos, R., Brito, H., Felix, R. A., & Mena, L. J. (2023). Role of Digital Transformation for Achieving Sustainability: Mediated Role of Stakeholders, Key Capabilities, and Technology. *Sustainability, 15(14)*, 11221. https://doi.org/10.3390/su151411221

Matteson, S., & Grant, M. M. (2024). Integrating Student Response Technology Into A Large Undergraduate Course: Students' Perceptions Of Their Motivations And Feedback. *TechTrends, 68*, 1013–1032. https://doi.org/10.1007/s11528-024-00996-5

Menon, D., Shorman, D. A. A., Cox, D., & Thomas, A. (2023). Preservice Elementary Teachers Conceptions and Self-Efficacy for Integrated STEM. *Education Sciences, 13(5)*, 529. https://doi.org/10.3390/educsci13050529

Merino, M., Tornero-Aguilera, J. F., Rubio-Zarapuz, A., Villanueva-Tobaldo, C. V., Martín-Rodríguez, A., & Clemente-Suárez, V. J. (2024). Body Perceptions and Psychological Well-Being: A Review of the Impact of Social Media and Physical Measurements on Self-Esteem and Mental Health with a Focus on Body Image Satisfaction and Its Relationship with Cultural and Gender Factors. *Healthcare, 12(14)*, 1396. https://doi.org/10.3390/healthcare12141396

Mondal, A. S., Zhu, Y., Bhagat, K. K., & Giacaman, N. (2022). Analysing User Reviews Of Interactive Educational Apps: A Sentiment Analysis Approach. *Interactive Learning Environments, 32(1)*, 355–372. https://doi.org/10.1080/10494820.2022.2086578

Mulder, W. R. S., Khoiri, N., & Hayat, M. S. (2023). Validitas media pembelajaran IPA berbasis web dengan pendekatan STEAM untuk meningkatkan kemampuan berpikir kreatif peserta didik: The validity of web-based science learning media using the STEAM approach to improve students' creative thinking ability. *Practice of The Science of Teaching Journal: Jurnal Praktisi Pendidikan, 2*(1), 11-17. https://doi.org/10.58362/hafecspost.v2i1.31

Nor, M. Z. M., & Mahmud, S. N. D. (2024). Empowering Scientific Literacy of Science Teachers: Systematic Literature Review (SLR). *International Journal of Academic Research in Progressive Education and Development, 13(1)*, 676–697. http://dx.doi.org/10.6007/IJARPED/v13-i1/20434

Ojong, A. S. (2023). Unraveling the Efficacy of Differentiated Instruction in Enhancing Second Language Acquisition: A Comprehensive Review and Future Directions. *International Journal of Linguistics, Literature and Translation, 6(6)*, 75-82. https://doi.org/10.32996/ijllt.2023.6.6.8

Petruse, R. E., Grecu, V., Chiliban, M.-B., & Tâlvan, E.-T. (2024). Comparative Analysis of Mixed Reality and PowerPoint in Education: Tailoring Learning Approaches to Cognitive Profiles. *Sensors, 24(16)*, 5138. https://doi.org/10.3390/s24165138

Quadir, B., Chen, N. S., & Isaias, P. (2020). Analyzing The Educational Goals, Problems And Techniques Used In Educational Big Data Research From 2010 To 2018. *Interactive Learning Environments, 30(8)*, 1539–1555. https://doi.org/10.1080/10494820.2020.1712427

Qushem, U. B., Christopoulos, A., Oyelere, S. S., Ogata, H., & Laakso, M. -J. (2021). Multimodal Technologies in Precision Education: Providing New Opportunities or Adding More Challenges? *Education Sciences, 11(7)*, 338. https://doi.org/10.3390/educsci11070338

Rice, M. F., & Ortiz, K. R. (2021). Evaluating Digital Instructional Materials For K-12 Online And Blended Learning. *TechTrends, 65*, 977–992. https://doi.org/10.1007/s11528-021-00671-z

Rosenthal, S. (2020). Media Literacy, Scientific Literacy, and Science Videos on the Internet. *Front. Commun*. 5:581585. https://doi.org/10.3389/fcomm.2020.581585

Sjolie, E., & Ostern, A. L. (2020). Student Teachers' Criticism Of Teacher Education – Through The Lens Of Practice Architectures. *Pedagogy, Culture & Society, 29(2)*, 263–280. https://doi.org/10.1080/14681366.2020.1729842

Strojny, P., & Dużmańska-Misiarczyk, N. (2023). Measuring The Effectiveness Of Virtual Training: A Systematic Review. *Computers & Education: X Reality, 2*, Article 100006. https://doi.org/10.1016/j.cexr.2022.100006

Sujanem, R., & Suwindra, I. N. P. (2023). Problem-based Interactive Physics E-Module in Physics Learning Through Blended PBL to Enhance Students' Critical Thinking Skills. *Jurnal Pendidikan IPA Indonesia, 12(1)*, 135-145. https://doi.org/10.15294/jpii.v12i1.39971

Sunarti, S., Anggraini, D., Sarie, D., & Jana, P. (2023). The Effectiveness Of Pop-Up Book Media In Learning Reading Skills Of Grade 2 Elementary School. *Jurnal Cakrawala Pendidikan, 42(2)*, 493-506. https://doi.org/10.21831/cp.v42i2.50381

Tang, K. H. D. (2022). A Model Of Behavioral Climate Change Education For Higher Educational Institutions. *Environmental Advances, 9*, 100305. https://doi.org/10.1016/j.envadv.2022.100305

Taye, M. M. (2023). Understanding of Machine Learning with Deep Learning: Architectures, Workflow, *Applications and Future Directions. Computers, 12(5)*, 91. https://doi.org/10.3390/computers12050091

Tetteh, C. K. (2024). R&D, Innovation And Labour Productivity: Evidence From The Manufacturing Sector in Ghana. *Scientific African, 24*, e02136. https://doi.org/10.1016/j.sciaf.2024.e02136

Tlili, A., Agyemang Adarkwah, M., Salha, S., Garzón, J., Kinshuk, & Burgos, D. (2024). The Effect Of Educational Mobile Games On Learning Performance: A Meta-Analysis And Research Synthesis. *Interactive Learning Environments*, 1–23. https://doi.org/10.1080/10494820.2024.2310135

Tlili, A., Ofosu, S., & Zhang, J. (2021). Pedagogical Beliefs, Teaching Practices And Use Of Open Educational Resources In The Republic Of Ghana. *Interactive Learning Environments, 31(5)*, 2665–2677. https://doi.org/10.1080/10494820.2021.1894453

Tulchinsky, T. H., & Varavikova, E. A. (2014). Expanding the Concept of Public Health. *The New Public Health*, 43–90. https://doi.org/10.1016/B978-0-12-415766-8.00002-1

Vallée, A., Blacher, J., Cariou, A., & Sorbets, E. (2020). Blended Learning Compared To Traditional Learning In Medical Education: Systematic Review And Meta-Analysis. *Journal of Medical Internet Research, 22(8)*, e16504. https://doi.org/10.2196/16504

Viberg, O., Grönlund, Å., & Andersson, A. (2020). Integrating Digital Technology In Mathematics Education: A Swedish Case Study. *Interactive Learning Environments, 31(1)*, 232–243. https://doi.org/10.1080/10494820.2020.1770801

Voogt, J. M., Pieters, J. M., & Handelzalts, A. (2016). Teacher Collaboration In Curriculum Design Teams: Effects, Mechanisms, And Conditions. *Educational Research and Evaluation, 22*(3–4), 121–140. https://doi.org/10.1080/13803611.2016.1247725

Wahjono, H., Wiyono, B. B., Maisyaroh, & Mustiningsih. (2021). Development of Blended-Learning-Based Semester Credit System Implementation Model to Improve Learning Service. *Information, 12(12)*, 511. https://doi.org/10.3390/info12120511

Wu, M.-J., Zhao, K., & Fils-Aime, F. (2022). Response Rates Of Online Surveys In Published Research: A Meta-Analysis. *Computers in Human Behavior Reports, 7*, Article 100206. https://doi.org/10.1016/j.chbr.2022.100206

Xue, L., Rashid, A. M., & Ouyang, S. (2024). The Unified Theory of Acceptance and Use of Technology (UTAUT) in Higher Education: A Systematic Review. *Sage Open, 14(1)*. https://doi.org/10.1177/21582440241229570

Zafar, S., Manjurekar, B., Kumar, N. P., & Khan, Z. A. (2014). Effects of FFCS (Fully Flexible Credit System) on Learning Experience And Academic Performance. *Procedia -Social and Behavioral Sciences, 143*, 4-7. https://doi.org/10.1016/j.sbspro.2014.07.347

Zhao, Y., & Ko, J. (2022). *Enhancements of Vocational Students' Engagement of Workplace Learning in the Industry-University Collaboration Learning Environment: A Case Study in the Greater Bay Area*. In: Hong, C., Ma, W.W.K. (eds) Applied Degree Education and the Future of Learning. Lecture Notes in Educational Technology. Springer, Singapore. https://doi.org/10.1007/978-981-16-9812-5_21

Zhou, Q., Zhang, H., & Li, F. (2024). The Impact of Online Interactive Teaching on University Students' Deep Learning—The Perspective of Self-Determination. *Education Sciences, 14(6)*, 664. https://doi.org/10.3390/educsci14060664