A SYSTEMATIC STUDY OF MULTIMEDIA IMPLEMENTATION AND ITS IMPACT TOWARDS USER ENGAGEMENT

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ABSTRACT

Multimedia has been a strategy in teaching processes, especially within the learning management system (LMS). However, multimedia tools have not delivered satisfaction towards the learning process. In addition, the lack of engagement within the LMS has been a real problem for e-learning. Therefore, this study aims to identify what the challenges are in implementing multimedia and how multimedia could enhance user engagement. This study hopes to give both academics and practitioners insights into a successful multimedia implementation within the LMS platform. This study is conducted through a systematic literature review (SLR) based on the PRISMA methodology, which contains four filtering phases: identification, screening, eligibility, and inclusion. The study managed to obtain 25 relevant papers on multimedia and user engagement after several filtering processes. It was found that interactive multimedia was the most implemented multimedia type. Furthermore, the pedagogical strategy was claimed the most important challenge that needs to be considered in multimedia implementation. Moreover, the results show that perceived interaction within multimedia could significantly enhance user engagement in LMS.

Keywords: *systematic literature review, multimedia, learning management system, user engagement*

INTRODUCTION

The development of e-learning processes has been quite remarkable over time, especially with the implementation of multimedia within the learning management system (LMS) (An & Chen, 2021). Multimedia is a combination of text, sound, video, art, or animation delivered by a digital platform, and also encompasses simple teaching tools (Vagg et al., 2020). The wide scope of multimedia implementation enables it to be designed using web or mobile devices (Miller et al., 2021). The advantage of multimedia is that it can represent educational information within the teaching process without having to derive great effort towards the students (Liu et al., 2019). Furthermore, multimedia components such as video and animation attract users' interest and attention due to the joyous dynamics of their functions (Chang et al., 2021; Sallman et

al., 2020). Over the past years, multimedia has been an effective tool to enhance user engagement in the LMS platform (Guntha et al., 2020). In addition, the implementation of multimedia emerges several teaching techniques within the LMS, such as cooperative learning that promotes discussion in an e-learning process (Zhang et al., 2020).

However, many papers stated several problems with the implementation of multimedia within the learning management system. Few higher education institutions have implemented multimedia within their e-learning process due to the lack of properties provided by internal governance (Fan, 2021). Besides that, the content of multimedia has not been organized effectively to ensure learners acquire relevant knowledge about the information needed, plus the challenges of structuring a quality learning model into the multimedia content

(Schüler & Wesslein, 2022). Moreover, critical thinking improvement within the multimedia content remains in consideration to enhance successful e-learning (Neffati et al., 2021). Although multimedia has been implemented in a few learning management systems, utilized multimedia tools have not delivered satisfaction towards the learning process (Knopf et al., 2020). Users' experience influences satisfaction, memory, and engagement of students in multimedia implementation (Arici et al., 2019).

In order to find solutions regarding the problems, this study carried out a systematic literature review (SLR) on multimedia implementation of the LMS and how it impacts user engagement. The study analysis is based on several prior relevant studies obtained from online databases. The study aims to find out what types of multimedia have been implemented from 2017 to 2021, what the challenges of multimedia implementation are, and what impact they have on user engagement. Furthermore, the outcome of this SLR hopes to offer insights for both academics and practitioners about how to structure conceptual models for multimedia in e-learning processes and how to implement multimedia in the best possible way.

The systematic literature review methodology is adopted from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which consists of four main phases: identification, screening, eligibility, and inclusion (Selcuk, 2019). This study is constructed based on PRISMA methodology due to its research of multimedia in several fields, such as a study on multimedia tools in the teaching and learning processes (Abdulrahaman et al., 2020), multimedia tools in health studies (Malale et al., 2020; Regmi et al., 2020; Steves & Scafide, 2021), neuroimaging tools in multimedia learning (Ozel et al., 2021), and also a study on exploring factors influencing knowledge management sharing mechanisms and technology (Sensuse et al., 2021). In addition, several research questions have been formulated, to be answered through this systematic review study:

- What types of multimedia have been implemented in the learning management systems?
- What are the challenges in implementing multimedia within the LMS platform?
- How can multimedia implementation in LMS enhance user engagement?

The results and discussions in this paper will answer the research questions, derived from the prior relevant studies. The study will also suggest some future works for the upcoming research on multimedia, especially regarding user engagement.

BACKGROUND STUDY

Multimedia

Multimedia is a term that refers to a variety of interactively distributed, electronic, or digitally manipulated forms of text, graphics, sound, animation, and video (Mayer, 2001). The extreme development of technology presently makes multimedia an important tool for engaging students in the e-learning processes within the LMS (Rajpal et al., 2019). Thus, with the implementation of interactive multimedia, students can freely and easily acquire knowledge, which will motivate students' participation in e-learning (Kao et al., 2019).

User Engagement

User Engagement is a fundamental factor to measure a successful product, specifically to measure continuous use. Several engagement methods have been studied in prior research. Vuković et. al studied the enhancement of user engagement by optimizing the use of technology, which can facilitate learning engagement (2021). Furthermore, technological tools, such as social media, have proven to enhance e-learning engagement (Valdez et al., 2022). Whilst both studies from Vuković and Valdez studied engagement from the perspective of technology, the perceived usefulness of the LMS content is said to motivate students' engagement in online learning/e-learning (Slattery, 2018).

METHODOLOGY

To analyze and identify what types of multimedia have been implemented in learning management systems, what the challenges are in implementing them, and how they impact user engagement, this study carried out a systematic review based on several prior relevant studies from different online databases. The relevant studies were filtered based on the PRISMA methodology (Selcuk, 2019), which consists of four main phases, including sub-phases such as protocol criteria, Boolean search process, inclusion and exclusion criteria, and data extraction. The primary paper selection will be delivered

by filtering nonrelevant studies, then several data was extracted to answer each formulated research question comprehensively. Furthermore, after conducting the research through several filtering stages, the findings will be summarized into a report.

Protocol Criteria

In this stage, a protocol criterion of the SLR was developed to specifically define the study. The protocol criteria section in this study aims to determine the keywords as the boundaries throughout the entire research process of SLR. The protocol criteria will also derive a relevant outcome that will answer the research questions. Population, intervention, comparison, outcome, and context (PICOC) are the criteria determined to specifically focus on the study's quality and relevant outcome. The protocol criteria is shown in Table 1.

Table 1.
Population, Intervention, Comparison, Outcome, and Context Criteria

Population	Multimedia, learning management system, information system development
Intervention	User engagement, challenges, multimedia type
Comparison	Identified multimedia type for UE enhancement; identifies challenges of multimedia implementation
Outcome	Comparison of multimedia type for UE enhancement; comparison of challenges for multimedia implementation; a better knowledge of UE
Context	Higher education

The population defines the main subject of this research, whilst intervention is the element that will be examined based on the research questions. Meanwhile, the comparison is comparing interventions amongst every related study. Furthermore, the outcome is the result of research questions and, finally, context defines the general field of this research regarding multimedia and its impact on user engagement.

Search Process

In order to obtain a quality outcome to answer the research questions, relevant prior studies regarding multimedia and user engagement were researched from various online databases with high-indexed papers. Relevant studies were found within five different online databases:

1. Association for Computing Machinery Digital Library (www.acm.org)
2. ProQuest (www.proquest.com/index)
3. ScienceDirect (www.sciencedirect.com)
4. SpringerLink (link.springer.com)
5. Emerald Insight (www.emerald.com/insight)

The five online databases determined were based on their reputations and qualities towards computer science studies. The candidate reference papers were limited between the years 2017 and 2021 with the keywords (Multimedia AND "Learning Management System" AND challenge AND "user engagement") for each online database. The Boolean search this study conducted can be seen in Table 2.

Table 2.
Boolean Search

Format ACM: [Title:(multimedia) AND Title:((learning management system)) AND All Field:(challenge) AND All Field:((user engagement))
Format ProQuest: multimedia AND ab(learning management system) AND challenge AND (user engagement) Date: From 2017 to 2021
Format ScienceDirect: Find items with these terms: multimedia AND (learning management system) AND challenge AND (user engagement)
Format SpringerLink: multimedia AND "learning management system" AND challenge AND "user engagement" Date: From 2017 to 2021
Format Emerald Insight: All Fields: multimedia AND ((learning management system)) AND (challenges) AND ((user engagement))

However, the Boolean search process is not the final step in determining this study's reference papers. After many papers were detected based on the keywords, inclusion and exclusion criteria were required in order to obtain relevant and high-quality reference studies towards multimedia and user engagement in the higher educational field.

Inclusion and Exclusion

The inclusion and exclusion criteria are carried out to specifically determine the scope of this study. The inclusion and exclusion criteria can be seen in the Table 3.

Table 3.
Inclusion and Exclusion Criteria

Stage	Inclusion Criteria	Exclusion Criteria
Identifying Stage	According to the Boolean search English language Publication year 2017–2021	Paper with non-English language Publication year outside 2017–2021 Duplicate paper
Screening Stage (Title and Abstract Selection)	Multimedia Learning management system (LMS)	Component except multimedia Non-learning management system (LMS) Duplicate paper Review paper
Eligibility Stage (Full-Text Selection)	Challenges of multimedia implementation Impact of multimedia on user engagement Open access paper Q1 and Q2 tier journal	Non-multimedia challenges Non-multimedia impact Non-accessible full-text paper Except Q1 and Q2 tier journal
Inclusion Stage	Research question relevancy	Research question non-relevancy

In this process, three filtering stages are implemented: the initiation stage, the title and abstract stage, and the full-text selection stage.

Data Extraction

In order to answer the research questions, various data was extracted from the previously selected papers after four filtering stages based on the inclusion and exclusion criteria. An MS Excel map was used to categorize each piece of data. The study divided the categorization as follows: references; title; problems; purpose; method; results; contribution; limitation; types of multimedia implementation; challenges of multimedia implementation; and impacts of multimedia towards user engagement. To maintain a quality study, the prior studies were mapped based on their journal ranking. The focus of this study is to answer the research questions; therefore, this study observes primarily the types of multimedia implemented so far, the challenges of multimedia implementation, and how they could impact user engagement.

RESULTS AND DISCUSSION

The results of each methodology phase based on PRISMA methodology will be discussed in this section, including the search process, publication source, publication type, and publication year. This section will also answer the formulated research questions stated earlier in this paper.

Systematic Literature Review Results

The study carried out four filtering phases in order to acquire relevant papers to synthesize. The overall primary studies selection process can be seen in Figure 1.

Figure 1.
Primary Studies Selection Process
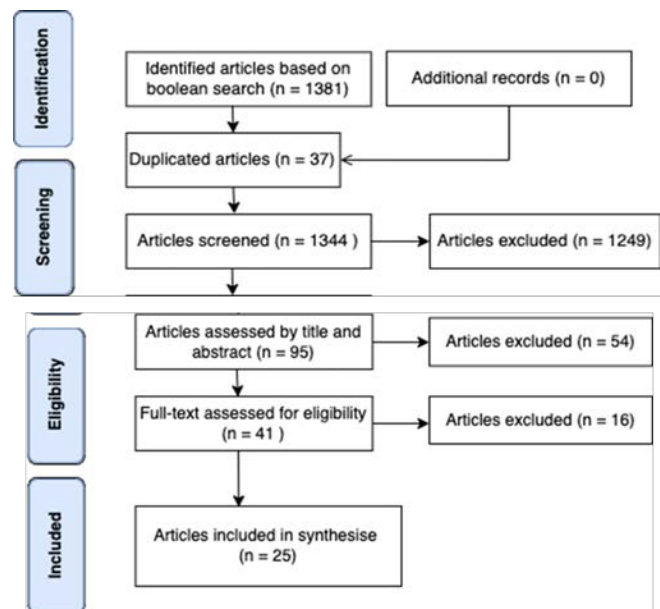
The study successfully detected 1,361 articles from five different online databases based on the identification stage, with 37 duplicated papers among them. The study assessed articles based on the title and abstract; 95 articles were derived from this stage. Furthermore, 41 full-text articles were obtained for the eligibility process. Finally, the study managed to obtain 25 articles included in the synthesis process due to their relevance and quality in answering the formulated research questions. In order to specifically define the 25 articles, an overview of the publication sources, publication types, and publication years is detailed next.
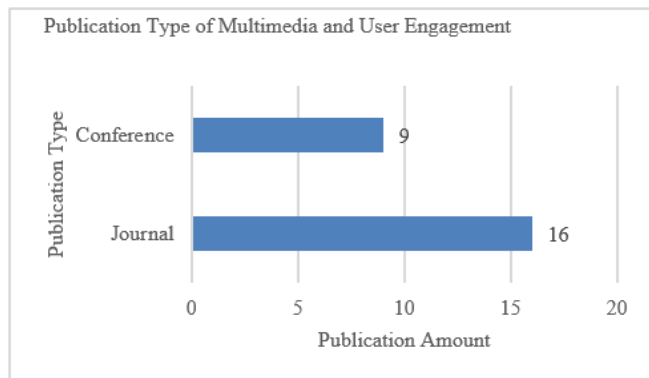
Publication Source Overview
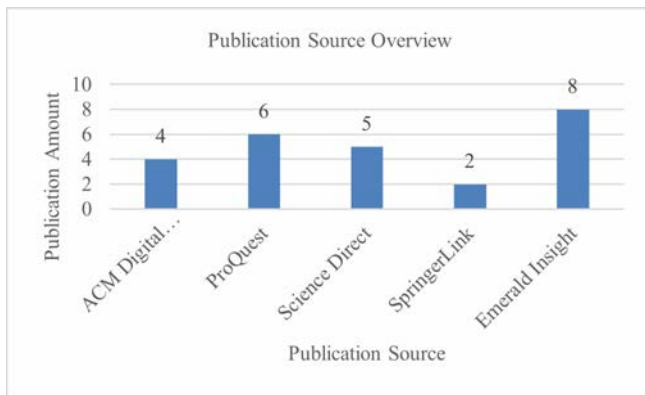
Publication Source Overview

The study managed to obtain 25 relevant papers on multimedia and user engagement from five different online databases, as shown in Figure 2.

The study acquired four relevant studies from the ACM Digital Library. Meanwhile, six credible papers on multimedia and user engagement were obtained from ProQuest. ScienceDirect also contributed to the findings of this study's relevant papers with five papers in total. The least credible papers found based on the included stage were obtained in SpringerLink, with only two papers. Emerald Insight published the greatest number of relevant papers with eight studies. These five different online databases were determined as ths study's reference sources due to the quality of these databases in computer science studies. Furthermore, these five different online databases contain highly ranked papers, which is

Publication Type of Multimedia and User Engagement

one of the inclusion criteria that this study has determined.

Publication Type Overview

The publication types that this study has determined were journals, book sections, books, conference papers, and trade publications. However, due to the quality and relevancy towards the research questions, this systematic literature review only manages to discover prior papers from journals and conferences. The publication type of the relevant prior studies towards multimedia and user engagement can be seen in Figure 3.

The study successfully obtained nine conference papers and 16 papers from journals within the five online databases previously mentioned.

Publication Year

According to Figure 4, two of 25 papers were published in 2017, and four of them were published in 2018. Furthermore, seven studies explored multimedia and user engagement in 2019. The study of multimedia decreased in 2020, with only four papers, due to the COVID-19

Publication Year of Multimedia and User Engagement
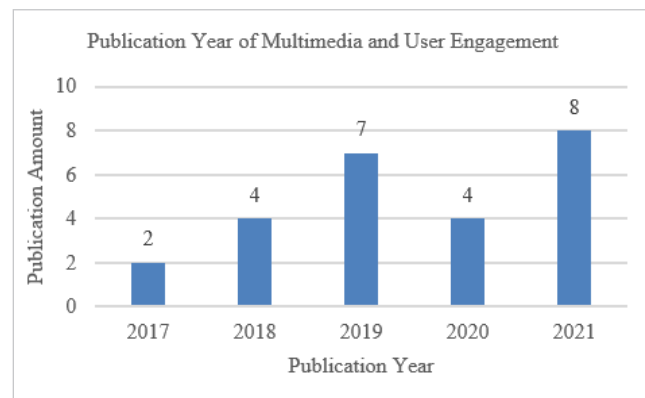
pandemic. However, studies towards multimedia increased in 2021, with eight publication papers. The author claims that this phenomenon is due to the lack of student engagement within the process of e-learning. Therefore, many researchers are eager to comprehensively study multimedia in order to identify solutions on how to effectively engage students, especially in higher education institutions.

RESEARCH QUESTIONS

Based on the data extracted from the 25 papers previously mentioned, this section analyzes the formulated research questions and the findings. The analyses will be structured based on research questions respectively.

RQ1: What types of multimedia have been implemented in LMS?

Table 4.
Types of Multimedia

No.	Multimedia Type	Frequency	References
1	Interactive Multimedia	10	(Alexiou et al., 2020; Alfalah, 2018; Chen et al., 2019; Draghici, 2021; Ferreira et al., 2019; Gudmundsson et al., 2018; Haron et al., 2017; Lubinski & Tama, 2021; Mathivanan et al., 2023; Sarker et al., 2019)
2	Linear Multimedia	9	(Akbarialiabad et al., 2021; Chiam et al., 2017; Das et al., 2019; Hasnine et al., 2021; Krishnaswamy et al., 2019; Kumar & Kumar, 2020; Oliveira, 2018; Salim et al., 2020; Ting et al., 2018)
3	Hyperactive Multimedia	5	(Aysolmaz & Reijers, 2021; Draghici, 2021; Gudkova et al., 2021; Onofrei & Ferry, 2020; Yaqin, 2020)
4	Multimedia Kits	2	(Al Natour & Woo, 2021; Bosman et al., 2019)

Based on Table 4, there were four types of multimedia implemented in the LMS platform, namely interactive multimedia, linear multimedia, hyperactive multimedia, and multimedia kits. According to Alfalah, interactive multimedia consists of tools to help impart knowledge and understanding, such as videos and virtual reality (2018). Based on the findings, ten prior studies implemented interactive multimedia towards the e-learning process. Two of them integrate audio-visual (Alexiou et al., 2020; Sarker et al., 2019), two also integrate informative multimedia tools (Ferreira et al., 2019; Haron et al., 2017), and the rest integrate personalized videos

(Alfalah, 2018; Chen et al., 2019; Draghici, 2021; Gudmundsson et al., 2018; Lubinski & Tama, 2021; Mathivanan et al., 2023; Sarker et al., 2019). Furthermore, nine studies implemented linear multimedia with flat videos in various educational disciplines, such as health (Akbarialiabad et al., 2021), business (Das et al., 2019), and others. Within the study's findings, an interesting multimedia type was discovered: hyperactive multimedia. This breakthrough integrates online gamification towards the LMS platform to motivate students' participation. Five of six studies were published in 2021 (Aysolmaz & Reijers, 2021; Draghici, 2021; Gudkova et al., 2021; Yaqin, 2020). Finally, only two studies implemented multimedia kits that integrate only audio within the e-learning process (Al Natour & Woo, 2021; Bosman et al., 2019).

RQ2: What are the challenges in implementing multimedia within the LMS platform?

In order to answer the second research question, the author will divide the analysis into four dimensions: technology, people, strategy, and environment.

Technology

According to Table 5, it was found that the technology factor was not a constraint factor towards the implementation of multimedia media in LMS. The high cost (Alfalah, 2018), technology quality (Chiam et al., 2017), and technology support (Haron et al., 2017) were claimed by three relevant papers as challenges in implementing multimedia.

Table 5.
Technology Factors of Multimedia Challenges Engagement

No.	Factors	Frequency	References
1	High cost	1	(Alfalah, 2018)
2	Technology quality	1	(Chiam et al., 2017)
3	Technology support	1	(Haron et al., 2017)

People

The next dimension in which this study seeks to analyze the challenges in implementing multimedia is the factor of people.

Table 6.
People Factors of Multimedia Challenges

No.	Factors	Frequency	References
1	Poor multimedia skills	11	(Al Natour & Woo, 2021; Alexiou et al., 2020; Chen et al., 2019; Das et al., 2019; Gudkova et al., 2021; Gudmundsson et al., 2018; Haron et al., 2017; Hasnine et al., 2021; Onofrei & Ferry, 2020; Salim et al., 2020; Yaqin, 2020)
2	Lack of preparation	2	(Bosman et al., 2019; Sarker et al., 2019)
3	Students' satisfaction	3	(Chiam et al., 2017; Das et al., 2019; Lubinski & Tama, 2021)

Based on Table 6, a total of 11 prior papers expresses that poor multimedia skill is the most challenging factor within multimedia implementation. Teachers with a lack of multimedia skills are unable to construct rich content within the process of e-learning via multimedia (Gudkova et al., 2021). In addition, the lack of multimedia skills will affect the perceived ease of use and perceived usefulness among students (Al Natour & Woo, 2021; Hasnine et al., 2021). Furthermore, teachers' lack of multimedia skills for creating learning content will produce low student engagement (Chen et al., 2019; Das et al., 2019; Gudmundsson et al., 2018; Salim et al., 2020; Yaqin, 2020). The least-claimed challenge in multimedia implementation was the lack of preparation for teachers to design learning content based on multimedia (Bosman et al., 2019; Sarker et al., 2019).

Strategy

The third dimension this study seeks to analyze is the challenges in implementing multimedia from factors of strategy.

According to Table 7, only two studies stated that interesting content (Chen et al., 2019; Salim et al., 2020) and content quality (Krishnaswamy et al., 2019; Sarker et al., 2019) are the factors of multimedia implementation challenges within the LMS platform. Furthermore, effective comments were concluded as the main factor of multimedia

Table 7.
Strategy Factors of Multimedia Challenges

No.	Factors	Frequency	References
1	Effective content	5	(Akbarialiabad et al., 2021; Hasnine et al., 2021; Oliveira, 2018; Ting et al., 2018; Yaqin, 2020)
2	Pedagogical strategy	8	(Akbarialiabad et al., 2021; Alexiou et al., 2020; Bosman et al., 2019; Chiam et al., 2017; Ferreira et al., 2019; Mathivanan et al., 2023; Onofrei & Ferry, 2020; Ting et al., 2018)
3	Interesting content	2	(Chen et al., 2019; Salim et al., 2020)
4	Human resources development	3	(Draghici, 2021; Kumar & Kumar, 2020; Mathivanan et al., 2023)
5	Content quality	2	(Krishnaswamy et al., 2019; Sarker et al., 2019)

Table 8.
Environment Factors of Multimedia Challenges

No.	Factors	Frequency	References
1	Learning environment	2	(Alfalah, 2018; Oliveira, 2018)
2	Bureaucracy support	1	(Krishnaswamy et al., 2019)

implementation, according to five prior relevant studies (Akbarialiabad et al., 2021; Hasnine et al., 2021; Oliveira, 2018; Ting et al., 2018; Yaqin, 2020). The most important factor of multimedia implementation challenges was stated in eight papers. Many teachers have encountered problems related to the evolution of the teaching process from traditional learning to online learning (Ferreira et al., 2019; Ting et al., 2018).

Environment

The last dimension this study seeks to analyze is the challenges in implementing multimedia from an environmental point of view.

Similar to the findings within technology factors, only a few studies stated that the environment

Table 9.
Process Factors of User Engagement Enhancement

No.	Factors	Frequency	References
1	Personalized learning	4	(Akbarialiabad et al., 2021; Gudmundsson et al., 2018; Mathivanan et al., 2023; Onofrei & Ferry, 2020)
2	Discovery learning	1	(Alfalah, 2018)
3	Efficiency	3	(Alfalah, 2018; Draghici, 2021; Gudmundsson et al., 2018)
4	Animation adaptive	1	(Aysolmaz & Reijers, 2021)
5	Perceived interactions	6	(Chen et al., 2019; Ferreira et al., 2019; Krishnaswamy et al., 2019; Oliveira, 2018; Sarker et al., 2019; Ting et al., 2018)
6	Perceived ease of use	1	(Chiam et al., 2017)
7	Scalabilities	1	(Gudmundsson et al., 2018)

is a challenge that needs to be considered regarding implementing multimedia within the LMS. The results of the environment dimension can be seen in Table 8.

RQ3: How can multimedia implementation in LMS enhance user engagement?

To answer the last research question, the analysis will be divided into two dimensions: process and people.

Process

Based on Table 9, there were seven process factors discovered for enhancing user engagement through multimedia, namely personalized learning, discovery learning, efficiency, animation adaptive, perceived usefulness, perceived ease of use, and scalabilities. The results show, based on prior relevant studies, that the use of multimedia will help personalize learning within the online learning process (Akbarialiabad et al., 2021; Gudmundsson et al., 2018; Onofrei & Ferry, 2020). In addition, Gudmundson et. al (2021) claim that the implementation of multimedia supports students' preferences for how they like to learn (Mathivanan et al., 2023). Furthermore, the implementation of multimedia impacts user engagement

due to its efficiency towards the learning process (Alfalah, 2018; Draghici, 2021; Gudmundsson et al., 2018). The preferences of use within the multimedia process will enhance students' engagement (Chiam et al., 2017). The results also show that six prior relevant studies stated multimedia implementation within the LMS platform impacts the users' interactions. Thus, perceived interactions were claimed as a successful factor in enhancing user engagement based on the process (Chen et al., 2019; Ferreira et al., 2019; Krishnaswamy et al., 2019; Oliveira, 2018; Sarker et al., 2019; Ting et al., 2018).

People

The second dimension that this study seeks to find how multimedia can enhance user engagement by analyzing the factors of people.

According to Table 10, there were five people factors discovered regarding enhancing user engagement through multimedia, namely easy to understand, perceived enjoyment, perceived usefulness, motivation,

Table 10.
People Factors of User Engagement Enhancement

No.	Factors	Frequency	References
1	Easy to understand	4	(Akbarialiabad et al., 2021; Mathivanan et al., 2023; Onofrei & Ferry, 2020; Sarker et al., 2019)
2	Perceived enjoyment	3	(Al Natour & Woo, 2021; Alexiou et al., 2020; Salim et al., 2020)
3	Perceived usefulness	7	(Al Natour & Woo, 2021; Alexiou et al., 2020; Chiam et al., 2017; Das et al., 2019; Lubinski & Tama, 2021; Onofrei & Ferry, 2020; Sarker et al., 2019)
4	Motivation	6	(Bosman et al., 2019; Chen et al., 2019; Draghici, 2021; Gudkova et al., 2021; Haron et al., 2017; Yaqin, 2020)
5	Student behavior	5	(Bosman et al., 2019; Kumar & Kumar, 2020; Oliveira, 2018; Salim et al., 2020; Yaqin, 2020)

and student behavior. The results show that the lowest factor of user engagement enhancement within multimedia is perceived enjoyment (Chen et al., 2019; Ferreira et al., 2019; Krishnaswamy et al., 2019; Oliveira, 2018; Sarker et al., 2019; Ting et al., 2018). Oliveira (2018) claims that multimedia enhances students' behavior, thus, the positive transformation within the students' behavior will eventually enhance their engagement towards the learning management system. Motivation was also stated as a factor of multimedia implementation that impacts user engagement within the massive open online courses (MOOC) (Kumar & Kumar, 2020; Yaqin, 2020). These results conclude that the usefulness of multimedia content is the most claimed factor that will enhance user engagement within the LMS platform (Al Natour & Woo, 2021; Alexiou et al., 2020; Chiam et al., 2017; Das et al., 2019; Lubinski & Tama, 2021; Onofrei & Ferry, 2020; Sarker et al., 2019).

CONCLUSION

This systematic literature review aims to analyze what types of multimedia have been implemented in the LMS platform, what the challenges are in implementing multimedia, and how multimedia can enhance user engagement. Based on the results, interactive multimedia was the most implemented multimedia since 2017. However, hyperactive multimedia was a breakthrough, from the intense research throughout 2021. Furthermore, to answer the second research question, the factors were divided into four dimensions: technology, people, strategy, and environment. Technology and environmental factors were found unnecessary when considered a challenge to implementing multimedia. Moreover, the results show that the teacher's lack of skill and knowledge was the main challenge towards multimedia implementation within the LMS platform. As for the strategy dimension, pedagogy was the most important factor to be considered. Finally, based on the results, perceived interactions and perceived usefulness were concluded as the most fundamental factors that could enhance user engagement in multimedia implementation.

This study shared some contributions towards multimedia implementation within the LMS platform and exemplified theoretical bits of knowledge for researchers about how to successfully design a multimedia conceptual model. This study has also discovered the most critical challenges for practitioners towards implementing multimedia and how multimedia could enhance user engagement. The contributions mentioned above indicate that this systematic study has met the goal of the research. However, this study was subject to some limitations, namely being limited to multimedia implementation in higher education institutions. Therefore, the author suggests analyzing multimedia implementation within middle and high schools for future work. Furthermore, this study is also limited to multimedia implementation in fully online learning. Future work and research is required to analyze multimedia implementation in a blended learning environment.

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