An Integrative Review: Application of Digital Learning Media to Developing Learning Styles Preference

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***Abstract*—The future of online learning or cybergogy known by several terms, such as blended learning, flipped classroom, or hybrid is something that cannot be avoided. This compelling situation is not due to the COVID-19 pandemic alone but has become a necessity for every student from school to higher education. This article aims to analyze and explain understanding in education related to the concept of "digital media", and all student responses including "learning styles", and related concepts, by reviewing, and synthesizing the literature using in an integrative review. A total of 154 qualitative and quantitative articles published between 2000 and 2020 were reviewed. Based on the inclusion analysis, 25 articles reveal things related to "digital media" and the behavior of students' "learning style" responses and what digital learning media should be. Concerning what is embedded in digital media that can result in different reactions from one another, digital learning media should be made by considering the behavioral reactions of students' "learning style" responses. Applying various digital media such as online platforms or applications in learning should directly affect different learning styles in education. Learning variations should also be offered when the learning media is created and used.**

***Index Terms*—Digital media, learning style, learning approach, cybergogy.**

I. Introduction

Digital media for learning (cybergogy) currently faces many challenges not only in terms of content, but also the distinctive challenges faced by educators in terms of how young people perceive, gather, and communicate to improve and build new technologies [1]. Digital media facilitate distance education, blended learning, or virtual learning where students more easily access information by adjusting their own time [2]. In this regard, teachers must choose the right learning media and learning methods in delivering teaching materials by adjusting the learning characteristics of the students they teach. Of course now what has changed is the nature of media, not about education it means education will always be empirical, theoretical, and practical, but learning media is always evolving according to learning needs and therefore it is justified that schools use media tools to students understand learning better [3].

Learning media development is also followed by determining the appropriate learning style. so that in carrying out learning, what must be considered is learning styles related to typical learning such as determining learning styles, combinations of learning styles, learning style profiles, and involvement of learning styles. [4]–[7]. As a learning experience, it would be better if the teacher's chosen learning method followed the learning style and learning media used. So that it can support the development of student skills, and the efficiency of the media used [5], [8], [9]. Online learning when dealing with digital learning media is limited to material design [10], so students face various problems in dealing with online classes such as lack of motivation and understanding of the material [11]. The discrepancy between digital learning design and the psychological readiness of students can hinder the learning process [12]. Research on learning styles starts from identifying and making instructions, to the strategies used [4], [13], [14]. Therefore, this article identifies the development of digital media in determining learning styles. Currently, online learning studies with the majority of research on digital media are conducted using correlational methods, experimental, and even descriptive studies to understand it. Digital development in determining learning styles this time is reviewed systematically. A lot of research on digital learning media, and learning styles [7], [15], [16]. But there are still rare who discuss the application of digital learning media that can develop learning styles.

A. Aims

This integrative review was conducted to identify the development of digital media in determining learning styles by analyzing definitions and examples in the existing literature

B. Research Question

How is the application of digital learning media that can develop learning styles?

II. Method

This research of literature on digital learning and learning style uses a systematic review. This method was chosen because it increases theoretical, empirical, and quantitative data. Data collection in this study was carried out through an analysis of 25 articles about digital learning and learning styles published in scientific journals from 2000-2020. 25 articles were analyzed qualitatively based on the required issues' differences, similarities, and characteristics. The results of the analysis are reported as findings. The online electronic databases used include Google Scholar, SAGE Publications, ERIC, ScienceDirect, Social Sciences Citation Index®, and Taylor & Francis Online, and are searched systematically using the following keyword combinations: media, digital, learning. Keywords are illustrated in Table I.

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TABLE I: KEYWORD SEARCH

Keywords Used in Search
Technology, Digital Technology, Digital Cultures, Digital Learning, Digital Media, Children's Media, Media Literacy, Cybergogy, Teaching, Learning, Learning Style, Learning Approach, Learning Combination, Multitasking, Interactive Earning, Learning Environments, Learning Experiences.

A. Eligibility Criteria

This review article uses inclusion and exclusion criteria to focus on the problem. The inclusion and exclusion criteria are determined in Table II, which were defined in English from 2000 to 2020.

TABLE II: INCLUSION AND EXCLUSION CRITERIA

No.	Inclusion Criteria
1.	Empirical and research-based publications
2.	The method used is a qualitative, quantitative, and mixed research study
3.	Peer-reviewed journal articles and specialty textbooks
4.	Only full-textual content articles
5.	Reports commissioned by international organizations
6.	literature review (including unpublished/gray literature: government reports, policy statements, conference proceedings, theses, dissertations, and research reports)
7.	English speaking only
8.	Published between January 2000 to December 2020

Based on the search described above, there were approximately 45,800 articles identified from the search described above, and 4730 articles were identified (see figure 1 for the data search process). The screening process for reducing duplicates and unrelated articles resulted in 3650 articles. The software chosen is Mendeley, a free reference manager and academic social network that helps researchers organize research, collaborate with others online, and find the latest research. 926 publications were identified as potentially relevant evidence-based sources on the search strategy. As a result, we followed a phased review - an initial review of the abstract, followed by an in-depth review.

In Fig. 1 the PRISMA guidelines are applied to select the selected literature. The search identified 45,800 citations from the search. After removing the duplicates 4730 articles remained. Then sources were filtered by title and abstract, and 1,080 non-conforming articles were excluded. Reasons for exclusion include but are not limited to types of digital media, learning styles, and learning approaches. Furthermore, for eligibility 154 full-text articles were assessed independently. Of the remaining articles, 35 were excluded for reasons including, but not limited to: the effectiveness of the instructional model of learning strategies, the nature of the resources, and the involvement of students in learning. This resulted in 25 articles which were eventually implemented into the final review.

B. Analysis

25 articles were analyzed qualitatively based on [17], and sections of articles containing examples or related definitions were analyzed. Integration is carried out based on the required issues' differences, similarities, and characteristics. The results of the analysis are reported as findings

C. Quality Rating

The studies that met the inclusion criteria were then assessed for quality using an assessment tool, which was developed intentionally based on the quality assessment criteria. This allows the reviewer to examine the main study in-depth and ascertain its relevance and usefulness

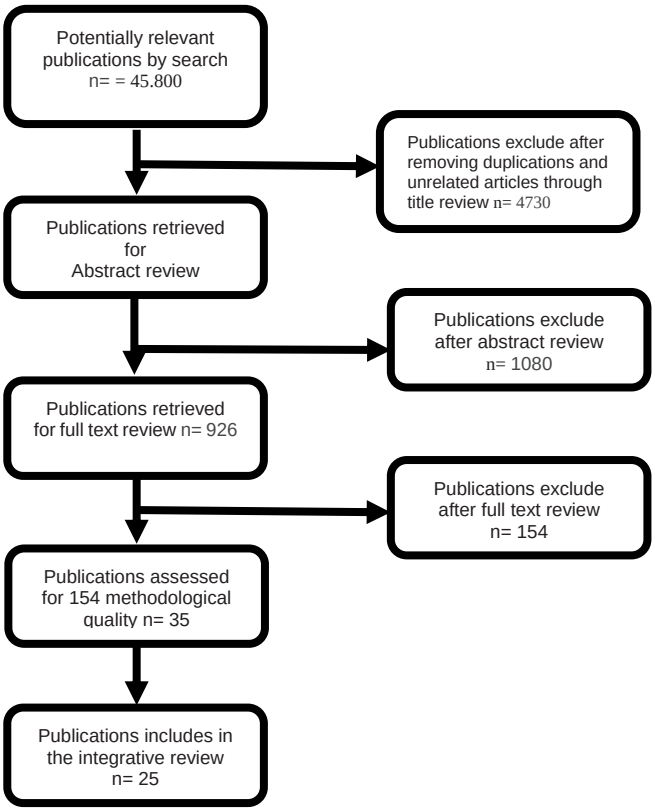

Fig. 1. Integrative review flowchart.

D. Coverage of Integrative Critical Review

This integrative review of the literature shows similarities, and two recurring friends appear in Table III.

TABLE III: KEY THEMES IN THE REVIEW

No	Theme
1.	Approach to Learning through Digital Media
2.	Learning Style with Digital Approach

III. RESULT

The articles have reviewed the results of research on digital media [2], [18], [19], learning activities [5], [20], learning styles [16], [21], [22], and learning modules [9], [23]. The result of the review is presented in Table IV and Table V.

A. Approach to Learning through Digital Media

TABLE IV: THE USED THEORETICAL PERSPECTIVE AND RESULTS IN THE INCLUDED ARTICLES

Theoretical Perspective	Reference	Results of the study
Media Digital	[24]	Application optimization for internet-enabled devices on learning
	[25]	To integrate learning and community engagement for young people into programs designed in digital media learning labs. Develop the concept of civic rhythms as a means to feel the social

	and affective contours of emerging civic engagement
[26]	Students are interested in trying out new content presentations and developing digital content instead of writing and presenting traditional semester reports and learning new tools for creating their media
[27]	Cultural diversity, religion, belief, and other social aspects, can be visualized using intercultural digital learning. Digital learning allows students to understand intercultural social phenomena. Students' understanding and experience are helped by digital media visualization.

In Table IV shows about theoretical perspective and result of approach learning through digital media. People have entered technological life where they improve or change our quality of life to accommodate changes in the environment, communication, and ways of meeting our needs [28]. The potential of a resource-based learning environment for teaching and learning is quite large, meaning that existing resources can be supported by an appropriate learning environment. Environmental support has a high impact on personalized learning support systems, for example, online learning environments can provide various types of displays such as animations, videos with learning materials, and structure of learning materials that can be made attractive [16]

Digital learning media is increasingly popular. With more and more people accessing digital media, there is a need for digital literacy stages to become a culture, including in the field of education. Currently, developing digital media literacy cannot be limited to mastery but analysis, evaluation, critical reflection including the impact on society, and the ability to make proper judgments about the role of technology in society and culture must be considered. [19], [20].

Digital culture is defined as all types of changes in personal and community life, and behavior caused by the presence of digital media, and networks and changing them quickly [28]. Therefore, schools are justified in utilizing digital media to help students "understand media" and current media developments so that students are always updated [3] because the purpose of the media is to facilitate communication and learning [2]. During the process of cultural development through the development of digital learning media, students commonly assumed that accustomed to researching selected topics, planning delivery media, learning outcomes and also using technical tools, and also mastering the material sufficiently [7]. Referring to the experience of children dealing with computers in their spare time, children are more than just mastering tools for retrieval of information, at the same time they can do several activities in one thing or what is commonly called multitasking [5]. Children's skills in dealing with Information Technology tools are strong support for interactive learning practices.

Students' ability in the field of information technology is included in the consideration of the media for delivering information and representing multimedia to accommodate various types of interactions, learning, and teaching styles [29]. For students used to multitasking out of doors about the classroom, the use of media combined with things to do which can be taken into consideration low interactive factors can assist lessen the extraneous cognitive load because fewer elements are involved in working memory [5]. The importance of informal learning and creative learning environment experiences supported by technology was also discussed by Lai *et al.* (2013) and Manca & Ranieri (2016). According to Thiele *et al.* (2014) [30]-[32], the use of technology that is following active learning techniques makes students more involved compared to ordinary learning.

B. Learning Style with Digital Approach

Theoretical perspective and result of learning style with the digital approach are presented in Table V.

TABLE V: THE USED THEORETICAL PERSPECTIVE AND RESULTS IN THE INCLUDED ARTICLES

Theoretical Perspective	Reference	Results of the study
Learning Style	[13]	Learning styles are detected automatically based on eye-tracking technology. There is a high correlation between the Felder-Silverman Learning Style and eye movements recorded during learning.
	[23]	Development of learning style-based modules from the learner's perspective with appropriate technology in a secondary education environment
	[33]	The use of virtual reality (VR) for conventional learning methods in various domains has a positive effect on Kolb's learning style
	[34]	improvement of the learning process is the contribution of the self-formative paradigm to change the context and attitudes associated with lifelong learning, based on self-education and e-Learning.
	[35]	Automatic detection of learning styles is an approach that detects student learning style preferences and then adjusts learning materials using the education system automatically

Student learning styles vary widely such as hearing, seeing, taking notes, imagining, and visualizing among many others (Guabassi *et al.*, 2019). Students are easier to explore learning skills such as the ability to focus on learning, the ability to think a lot, coordinate attention using their learning style, and understanding learning styles can help learn according to their strongest abilities.

Cybergogy is a form of independent learning that occurs through professional guidance using the Internet [36]. Using the Cybergogy approach which is an educational method in the era of digitalization of learning that utilizes information and communication technology empowerment facilities that are used for students' cognitive, emotional, and social progress [37].

In the classroom, students with visual learning styles performed very well because all tests were carried out in a written "visual" format [38] and when outside the classroom using a computer there were no significant differences. Because the characteristics of visual learners have a clear imagination in seeing pictures, they visualize what they learn in their minds. Based on the research Shaffiei *et al.* (2014) [39] results of visual learners prefer to use pictorial characteristics in their learning. Cybergogy learning is here to overcome the problem of different learning styles. In

cybergoth, students are free to determine their learning style both visually and audio-visually.

The utilization of information technology has a positive impact on learning and provides a fun and interesting learning atmosphere [40]. If students are aware of their learning style preferences research has shown that they prefer to seek learning environments and tools that enhance these preferences [41]. Different learning styles support each student to work at their best, provide opportunities to process assignments, encourage increased interest in learning activities, and create positive learning motivation [42]. The other is that the use of VR gives students a virtual experience through watching videos. Students realized that in the application of VR HMD in learning, the video was able to present a concrete type of experience but not conceptual knowledge, they feel that VR HMD is easy to use when facilities and resources are adequate, and based on research results the use of VR HMD increase learning efficacy and academic ability. [33]. According to Bahari (2022) and Hoda *et al.* (2022) [43], [44], the findings show that using technology-assisted learning can result in a meaningful increase in learning effectuality as measured objectively and subjectively, technology-assisted learning considers the entire course to be easier, and assessment of learning and generally refers to the extent to which students perceive the subject matter to be learnable. Furthermore, learning styles affect learning satisfaction in technology-assisted learning environments because the reduced risk of weak study group support offsets the benefits of increased learning effectiveness.

There are some learning design models, like Integrated Learning Design Environment (ILDE), ARCS model, The Balanced-Learning Design (BLADE) Model, and Interactive Learning Model (ILM) [29], [45]–[47]). The Learning Design Model has modules that are effective for visual learners, active learners, and reflective learners [23]. Online modules help students to improve their listening and speaking skills [9]. Cybergogy provides benefits for everyone, but the understanding of the specific benefits will vary for each person depending on the ability to receive the learning available online [36]. Thus recognizing learning preferences, learning style profiles, and involving student study groups will be an important part of the learning style component [29], [47].

Summary of research results and key points identified are presented in Table VI.

TABLE VI: SUMMARY OF RESEARCH STUDIES INCLUDED IN THE INTEGRATIVE REVIEW

No.	Article, Country	Method	Key points identified
1.	[19] Australia	Review	A proposed framework for developing digital media literacy and training students in digital media invention helps discover the training needs of students and teachers for virtual media output competently and communication in their disciplines
2.	[20] Norway, Sweden	Review	Shows how participants align their actions both on and in front of the screen and where splits and pauses are oriented as important aspects of organizing activities. In addition, shows how past and present technologies are linked together in the concept of literacy culturally and historically
3.	[5] USA	Experiment	Inform students on the state of multitasking. The findings show that the multitasking state can break down thinking in the acquisition of knowledge. This results in another cognitive load that overloads working memory. Students perform better when they focus on one task at a time especially when they are learning new material in and out of class.
4.	[35] Argentina	Theoretical and Experimental Research	Propose Automatic detection of learning styles is a process of using students' learning preferences in the education system. Automatic detection of learning styles overcomes several problems related to inappropriate questionnaires
5.	[7] USA	Mix Method Research	Seeing students' interactions with self-produced digital media, satisfaction, and learning styles.
6.	[18] Jordan	A mixed-methods approach	This study explores preservice teachers' perceptions of technology integration into educational programs and assesses satisfaction with preparation
7.	[2] Thailand	Review	Describes a system that can be used for teaching and learning in schools using technology as well as a system used as responsible online information.
8.	[1] USA	Review	A critical approach is needed to understand participatory media pedagogy. Part of the challenge educators face is in looking at the ways young people come together and communicate to improve/build new technologies.
9.	[48] USA	Review	Explores digital media and technologies to support data-driven teaching and learning by highlighting the need to more closely investigate how data is used to support learning and some of the problems and opportunities associated with the productive use of data.
10.	[8]	Review	Inspires a more independent and self-regulated learning approach, driven by students' intrinsic motivation which can eventually turn into self-determination.

11.	[9] Slovakia	Research	Explaining Online modules help students to improve speaking and listening skills, as online exercises and assignments provide authentic opportunities to practice skills through real and direct communication
12.	[49] Iraq	Research	Based on the results of the study, although the integration of learning style theory does not positively affect the model, empirically its impact contributes to education. There is no significant difference between students' willingness to adopt e-learning and their satisfaction based on learning style
13.	[23] Malaysia	Research	This showed that the Isman Learning Design Model that notices learning from the interpretation of learners based on the perspective of content is appropriate in designing and developing Physics modules based on learning styles and proper technology in the secondary education circle. Effective modules for visual learners, active learners, and reflective learners.
14.	[16] Thailand	Research	Explain Environmental support has a high impact on student efficiency in personalized ubiquitous learning support systems. Whereas students at high achievement levels perceive ease of use with a positive attitude that influences their decision to use a personalized ubiquitous learning support system, as well as their subsequent actual use.
15.	[21] South Africa	Research	Development with TETS strategy. Most students learning styles are different or assimilated.
16.	[22] Taiwan	Research	Using multimedia teaching styles to improve student learning attitudes. The use of multimedia teaching style has a significant effect on students' learning attitudes with different learning methods in teaching
17.	[28]	Review	All these 'gogies' will make the lives of teachers easier if they have the competence to use and understand the digital system that governs our educational life in the 21st century. The life of a person with a digital culture enters our classrooms, homes, neighborhoods, and communities
18.	[6] Hungary	Review	The articles reviewed in this study were carried out by identifying application development using adaptive learning that could affect learning styles.
19.	[50] Indonesia	Research	In this study, digital learning using augmented reality had good results and was proven to help students learn effectively. The average score increases so that applying digital media also affects learning styles.
20.	[10] Germany	Experiment	This study can show that providing simple options for digital learning media to increase perceived autonomy, intrinsic motivation, and learning value is a motivational enhancement strategy that can be implemented as well as possible.
21.	[33]	Research	Seeing the effect of using HMD in learning. And the influence of the concrete experience on learning style
22.	[51] Hongkong	Quantitative Research	See the comparison of face-to-face learning using technology. Online learning environments can provide listening practice, but their effectiveness may not be comparable to conventional classroom settings
23.	[52] Australia	A case-study approach	This article examines digital media as a new concept as a play and learning experience for early childhood. Integrating children's lives with play-based learning through technology.
24.	[15] US	Quantitative Research	This article discusses learning style groups with experimental, divergent, assimilator, and convergent types. Research proves not all learning styles have a significant difference in academic achievement. The diversity of individual characteristics under various conditions tends to produce different results.
25.	[42] Kazakhstan	Review	Proving the practicality of different learning to bridge the knowledge gap. Different learning strategies can be added to foster student understanding as a good learning tool.

IV. Discussion

This Integrative Review is based on an analysis of the included articles showing the impact of learning with digital media and the systems used in using technology [2], [7]. This is also a challenge for multimedia design makers where the media created must have clear guidelines in the designs created. The importance of informal learning and creative learning environment experiences supported by technology was also discussed by Lai *et al.* (2013) and Manca & Ranieri (2016). According to our review, achieving these benefits is the most important reason for designing and implementing digital media integrated learning styles so that the learning process carried out and the learning media used are following the preferences of students' learning styles. This statement

strengthens by McGovern *et al.* (2017) [53] that learning with a digital approach can improve learning styles by expanding the learning experience. Learning styles created from digital media environments can also affect cognitive load [54]. Because the higher the digital literacy, the higher the metacognitive listening of students towards learning styles [55]. In this study, the uses of technology and digital boundaries are presented not only in terms of content but also in style. [2]. A critical approach is needed to understand pedagogical media, especially in the form of participatory, all forms of learning approaches will make it easier for teachers if they understand the digital system that regulates educational life today [1], [28].

The current challenge is the changing nature of resources and the development of learning strategies that involve technology and the role of software developers [21]. So that the determination that students make has an impact on whether or not the choice of learning style. In reviewing learning media, educators and/or software developers need to present a system that uses technology in schools with responsible use of online information, and an active approach to supporting the needs of up-to-date learning experiences [2], [7], and such as the Interactive Learning System (ILS).

When starting to use different learning techniques, the software can be introduced first to spread knowledge [42] an ILS or educational design approach can encourage students to create their media to use. All of this is used to achieve more effective interactive learning and when digital media is created by students themselves, the learning media can lead to learning satisfaction and affect their learning style [7]. Apart from that, all is that students learn in different ways.

V. Conclusion

The application of digital learning media can be done by learning cybergogy. This learning exists to address the problem of different learning styles. Like students with visual learning styles, the media developed must be able to visualize what they learn in their minds. The use of VR as a learning medium can provide concrete experiences in learning where learning styles also affect learning satisfaction in a technology-assisted learning environment.

The development of technology affects student learning styles [49]. This review provides a synthesis of the determination of learning styles that are influenced by technology, namely digital media as a learning tool that is adapted to students' learning styles. Digital media affects learning styles such as determining learning styles, combinations of learning styles, learning style profiles, and learning style involvement. The development of various learning media makes many choices of learning styles for students. Based on the literature review, there are learning media that are suitable for the student's learning environment and create a concrete experience in learning. Teachers need to see their students learning and provide learning that is appropriate to their student's learning styles. Learning designed to fill students' learning needs becomes an important reason to design digital media as a means of learning that is appropriate to students' learning style preferences.

Conflict of Interest

The authors declare no conflict of interest

Author Contributions

Yunisca Nurmalisa, Sunyono Sunyono, Dwi Yulianti, and Risma Margaretha Sinaga carried out the literature study and quality assurance.

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