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LITERATURE REVIEW: INTERACTIVE MULTIMEDIA FLOWCHART WITH THE HELP OF CHATBOT AI TO IMPROVE THE SELF-REGULATED LEARNING ABILITY OF STUDENTS IN INDONESIA

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Abstract

The development of the Smart Society 5.0 era requires learning innovations that are able to integrate information and communication technology (ICT) into the educational process effectively and ethically. This study aims to analyze the potential and relevance of interactive multimedia flowcharts assisted by AI Chatbots in improving students' self-regulated learning (SRL) skills. This paper uses an analytical literature review approach with two main focuses: (1) defining the concept of interactive multimedia flowcharts assisted by AI chatbots, and (2) examining its influence on students' SRL skills. Data was obtained from various credible scientific sources such as Springer, Taylor & Francis, MDPI, ScienceDirect, and Google Scholar. The results of the study show that interactive flowcharts function as visual tools that help students formulate their thoughts systematically, while AI chatbots act as learning partners that provide personalized and real-time feedback. The combination of the two results in an interactive learning environment that can stimulate student planning, supervision, and self-reflection as the core of the SRL process. Conceptually, the synergy between interactive multimedia design and artificial intelligence is able to strengthen the cognitive, metacognitive, and motivational dimensions of students. Thus, this innovation has the potential to become a digital learning model that supports the development of learning independence, critical thinking, and lifelong learning in the context of higher education in the digital era.

Keywords: interactive multimedia, flowchart, AI chatbot, self-regulated learning, higher education

INTRODUCTION

The world is currently in an era of Society 5.0 or often also referred to as the term Smart Society 5.0. The term was first coined by the Government of Japan in 2016 in the 5th Century Science and Technology Basic Plan (2016-2020) initiative. With the growing information and communication technology (ICT) rapidly, it is important to design comprehensive educational innovations so that ICT This is not a significant obstacle to the improvement and transformation of education (Sancho-Gil, Rivera-Vargas, & Miño-Puigcercós, 2020). The Challenges of the Times Smart Society 5.0 and ICT, is a challenge for the world of educational technology. Because, according to Association for Educational Communications and Technology (AECT, Educational technology functions as an ethical study and practice that aims to facilitate learning processes and resources (2008) (Huang, Spector, & Yang, 2019). In addition, continuous learning media innovation is needed as long as humans are still learning (Kristanto, 2016).

In response to this, the researcher conducted a study on the development of multimedia learning for students. This is because students are one of the components of the demographic bonus that Indonesia has today. However, students often experience problems in self-management, because the majority of students are teenagers who are transitioning to early adulthood (Rahmadani & Mukti, 2020). Multimedia innovation Flowchart ChatBot AI-assisted interactive, is a combination of multimedia aspects of learning, interactive learning, Flowchart or flowcharts, and the novelty of the times in the form of ChatBot AI. With multimedia development studies Flowchart interactive assisted AI chatbot is expected to be able to improve the capabilities of self-regulated learning student. If students have this ability, they are expected to be able to plan, organize, and evaluate themselves on an ongoing basis to complete

learning with better performance (Güner & Erbay, 2021; Kumyoung, Kessung, Pinasa, Srijumnong, & Inyai, 2024). That way, this ability will support the ability to critical thinking, creativity (Akpur, 2025), learning independence (Hennecke & Kulkarni, 2024)and lifelong learning (Alvarez, Jivet, Perez-Sanagustin, Scheffel, & Verbert, 2022). This is in line with Indonesia's seriousness to advance its nation through inclusive lifelong learning (Muhammad, 2023; UNESCO, 2023).

METHODOLOGY

To further examine the topic of interactive multimedia flowcharts assisted by AI chatbots and self-regulated learning capabilities, this study uses an analytical literature review writing approach.There are two key questions to study this topic. First, what is AI-assisted interactive flowchart learning multimedia? Second, how does interactive multimedia flowcharts assisted by AI chatbots affect students' self-regulated learning abilities? These two questions will then be elaborated in several stages, namely theoretical, integrative, and methodological. Theoretically, the author will explain defining variables, including interactive flowchart learning multimedia assisted by AI chatbots and self-regulated learning capabilities. In terms of integrative, the author will present some previous research related to the topic, as well as some findings from other studies related to the topic. At the methodological stage, the researcher will present research gaps and recommendations for findings that can be further researched. To gain access to credible research, researchers use trusted journal platforms, such as: Google Scholar, Springer, MDPI, Taylor & Francis and Science Direct. The keywords used for searches for journals and related articles are, interactive learning multimedia, AI chatbots, self-regulated learning, and students.

RESULTS OF RESEARCH & DISCUSSION

Interactive Multimedia Flowchart

Multimedia is a learning medium that has various components such as text, illustrations, images, sounds, and various kinds of visual and non-visual representations (Jingwei Li, Antonenko, & Wang, 2019). In recent decades, multimedia has often been used in learning both as a medium and a learning environment because multimedia facilitates the optimization of the combination of text and image learning which has been proven to improve learning memory and comprehension (Jingwei Li et al., 2019; Lindner, Eitel, Barenthien, & Köller, 2021). Media Flowchart refers to a type of diagram that represents a series of works or processes (Odiliobi, 2021). Media Flowchart Included as a visual learning medium for charts (Aulia, Herawati, & Asmendri, 2020). Flowchart Facilitate the presentation of the overall material with good contextual relations (Kustyarini, Utami, & Koesmijati, 2020).

This medium is a set of visual tools that break down complex information into smaller components that are interconnected in a sequence (Grosskinsky, Jørgensen, & Hammer úr Skúoy, 2019). Also revealed by (Odiliobi, 2021), Flowchart is an image that contains specific symbols that are part of a construct. This medium is easy to use and translate even with language limitations. Deep (Aulia et al., 2020) It was revealed that Flowchart is a learning medium that shows a process chart arranged according to the sequence or flow of procedures. Media Flowchart is used in various fields and is one of the productivity tools (Odiliobi, 2021). Characteristic Flowchart standardized on American National Standards Institute (ANSI)/ ISO, Among them: there is a box containing instructions, arrows as navigation, generally operated from top to bottom, left to right, and there are keywords from the material taught (Aulia et al., 2020; Odiliobi, 2021)

When used in learning, Flowchart Not only useful for students but also teachers. For students, Flowchart contains a set of procedures that help them to prepare before studying, provide an overview and limitations of the overall scope of work, and help them to evaluate learning. For teachers, Flowchart help them to Tracking students' development, providing information about Feedback that are specifically required by the learner, and the means to facilitate the practice carried out by the learner (Grosskinsky et al., 2019). In general, according to (Odiliobi, 2021) Utilization Flowchart In learning, it has advantages, namely improving the quality of teaching plans, simplifying ideas and increasing understanding, increasing the attractiveness of learning, and actively involving students.

In addition, according to (Aulia et al., 2020; Jack Li, 2022), advantages of media utilization Flowchart Namely: helping teachers deliver material easily, quickly, and systematically, improving the quality of learning for a shorter learning duration, improving learning outcomes, and guiding students without the help of teachers. Interactive learning media is a medium that can capture, process, store, and discard processed information. In general, the principles and objectives of interactive learning media are to enhance active learning (Kustyarini et al., 2020). This interactivity refers to a type of learning where students can interact freely with learning resources and the learning process (Gever et al., 2021). Interactive learning aims to improve learning interaction between teachers and students. Media interactivity is useful for building a relationship between teachers and students' psychological needs. This

interaction can be in the form of one-way, two-way, or multi-directional communication or Multi Ways Communication which enhances the attractiveness and enriches the learning experience and variety (Kustyarini et al., 2020).

Chatbot AI

The use of AI in the world of education is increasing and growing rapidly (Kooli, 2023) The popularity of the use of AI chatbots is increasing along with the development of technology Mobile (Hwang & Chang, 2023) and has increased since the end of 2022 (Kooli, 2023). Chatbots provide a learning interaction experience without space and time limits (Hwang & Chang, 2023; Kooli, 2023), increasing the inclusivity of the learning environment (Kooli, 2023), real-time interaction, improving communication skills between students, and learning efficiency of students (Hwang & Chang, 2023; Khotimah et al., 2025) AI chatbots are artificial intelligence dialogue systems that are able to interact with humans by providing appropriate answers to a series of questions given by their users (Adiguzel, Kaya, & Cansu, 2023); The chatbot system uses Natural Language Processing (NLP), so that this artificial intelligence is able to respond to its users like fellow humans (Adiguzel et al., 2023). AI chatbots have the ability to converse with humans by providing answers in the form of written or verbal text (Deng & Yu, 2023) or also known as conversational agents (CA) in learning (Ait Baha, El Hajji, Es-Saady, & Fadili, 2024).

In addition, AI chatbots also have four characteristics that distinguish them from ordinary dialogue systems, namely simulating human conversations, communicating through written and verbal texts, not being present in physical form, and unlike avatars that represent humans in a virtual environment (Nee et al., 2023). Chatbots provide a personalized, inclusive, and enjoyable learning experience (Ahmad, Umirzakova, Mujtaba, Amin, & Whangbo, 2023). In this case, AI chatbots are seconded to multimedia utilization Flowchart interactive. So, this AI chatbot acts according to the paradigm (AI in Education) AIEd AI-supported. Namely, where AI behave as collaborators who support students while doing Active Learning (Adiguzel et al., 2023). This AI chatbot acts as a Learning Partners (Deng & Yu, 2023). One of the advantages of using AI chatbots is a personalized learning experience with a duration of feedback Real-time (Adiguzel et al., 2023). For teachers and administrators, AI chatbots increase the productivity of the teaching and learning process (PBM), because it is able to provide assessments Real-time From the learning process/student performance (Adiguzel et al., 2023), even in a short period of time with a more optimal level of accuracy compared to human analysis results (Kooli, 2023). The sophistication of chatbots with artificial intelligence used in learning environments. provides opportunities to improve the learning experience, because its sophistication makes it go beyond the limits of traditional learning and E-learning existing (Ait Baha et al., 2024).

However, the ethics of using chatbots are still unclear and are still evolving along with the development of AI itself (Adiguzel et al., 2023; Hwang & Chang, 2023; Kooli, 2023). However, this also shows that there are opportunities and spaces that are wide open for researchers and teachers in the field of education, to aggressively innovate using AI to enrich teaching and learning (Hwang & Chang, 2023). In a study on the use of the FOXI chatbot, which is a chatbot developed in training Collision Avoidance Regulations (COLREGs) For Adult Students Nautical Science at University of South-Eastern Norway, shows that there is a positive response of students to the use of the FLOKI chatbot as evidenced by the usability value System Usability Scale (SUS) The product reaches a quartile value of 3 or is eligible for use (Sharma, Undheim, & Nazir, 2023). In a meta-analysis study, AI chatbots were also shown to be able to improve explicit reasoning skills, learning achievement, knowledge retention, and learning interest. However, it is still lacking in terms of triggering critical thinking skills, learning interactions, and motivation (Deng & Yu, 2023). Some studies have also shown learning outcomes that are in contrast to improved learning (Nee et al., 2023). In addition, in the study (Ait Baha et al., 2024) Chatbots also improve the individual's learning experience, as the individual can learn at their own pace, reducing the pressure of stress, provides time-efficient use, as well as motivation. The use of AI chatbots in a classroom increases the interaction of individuals, increases individual participation and objective learning experience.

AI chatbots are not only used in formal learning environments but are also used in health education, such as education for prostate cancer patients in Germany. When used to educate patients, chatbots have proven informative in raising awareness and prevention about the disease, and support care (Görtz et al., 2023). In addition, AI chatbots have also been shown to improve self-directed and personalized learning junior doctors post-COVID pandemic (Xie, Seth, Hunter-Smith, Rozen, & Seifman, 2024). There are ethical pros and cons as well as learning outcomes from using chatbots. Thus, to use it, good cooperation is needed between policy makers, education administrators, teachers, and students to ensure the optimization of the responsible use of AI (Adiguzel et al., 2023; Doris M. & Brennan, 2023). It is therefore important to condition the use of AI chatbots wisely and further research.

Students' Self-Regulated Learning Abilities

Ability Self-Regulated Learning (SRL) is one of the abilities that must be possessed by 21st century students (Alvarez et al., 2022). SRL helps students to become lifelong learners independently (lifelong learner) who think critically and creatively in solving problems, so as to be able to adapt to the challenges of the changing times (Brenner, 2022). Some of the figures who studied Self-Regulated Learning among them were Berry J. Zimmerman, Pintrich, Boekarts, and Winne & Hadwin. In learning, this ability is defined as an individual's independent effort to initiate, maintain, and orient his/her cognitive, affective, and behavioral abilities systematically to achieve the success of the final learning goal (Daumiller & Dresel, 2019). It is also mentioned by Zimmerman (2002), that SRL is an approach student-centered that enable individuals to effectively manage their cognitive abilities to achieve specific learning objectives through Self-Monitoring and self-directed processes Sustainably (Geng & Su, 2025).

The study of self-regulated learning is also in line with the theories of constructivist figures such as Vygotsky and Bandura. According to Zimmerman & Schunk (2004) in (Boon, 2024), the concept of SRL departs from Bandura's theory of self-efficacy which was then initiated into social cognitive theory. Bandura (1997) revealed that while working with young children, he found that their (young children's) belief in their self-efficacy was determined by their self-regulating ability to think and behave. Children with good SRL skills, are able to acquire knowledge and develop self-efficacy better (Boon, 2024). In line with what was expressed by Vygotsky (1978) that self-regulation bridges the personal form with the social form of learning (Brenner, 2022).

In the last decade, the number of SRL studies in the field of education has doubled (Araka, Mines, Gitonga, & Oboko, 2020). SRL is not an innate ability, but an evolving ability, dynamic or variable in nature and can be improved through training or instruction (Brenner, 2022; Kumyoung et al., 2024). Completing a specific task or performance requires a specific SRL strategy, so different tasks require different SRL strategies for each individual (Boon, 2024). This certainly makes standardization of SRL a research challenge in itself, such as in evaluation instruments, demographic differences, and individual personalization (Boon, 2024; Brenner, 2022). According to Boekarts (1999) in (Daumiller & Dresel, 2019), there are three main layers in SRL and these three layers play a role in the regulation of individual motivation. First, the deepest layer in the form of cognitive strategies. Second, the middle layer is in the form of metacognitive control. Third, the outermost layer is in the form of self-regulation.

In addition, there are also several other types of SRL models. Mentioned by (Alvarez et al., 2022) In his writing, there are at least two SRL models/scopes of work that are most often used, namely the Pintrich model and the Zimmerman model. These two models are in the form of phases that are cyclical (Boon, 2024). In the Pintrich model, the SRL process exists in four phases, namely: phase Forethought, Planning, and activation; phase Monitoring; phase Control: and phases reaction and reflection (Alvarez et al., 2022) On the other hand, Zimmerman's SRL cycle model is based on Bandura's cognitive social theory which assumes SRL as a learner's strategy to manage their learning independently and sustainably to achieve their goals (Boon, 2024). In the Zimmerman model, there are three phases, namely the Forethought: With regard to the individual's personal goals, the Performance: Monitoring Task Work by Individuals, and Phases Self-reflection: individuals reflect and evaluate their performance (Alvarez et al., 2022; Boon, 2024; Brenner, 2022)

Each model has differences in defining SRL strategies, but there are several similarities that emerge from SRL models, as follows: first, the individual is an active participant in the learning process; second, individuals can supervise, control and regulate aspects of cognition, motivation, and behavior; third, there is a final goal or standard that allows individuals to compare their learning process; fourth, there are Self-regulation On individual cognition, motivation, and behavior bridges the relationship between the individual's personality, learning context, and final achievement (Alvarez et al., 2022)

AI-Assisted Interactive Multimedia Flowchart to Improve Students' Self-Regulated Learning Abilities in Indonesia

Multimedia enriches individual learning experiences. With a diversity of visual and visual components, this increases the absorption of students (Lindner et al., 2021). Nowadays, individuals also tend to be easily bored when the learning process takes time. If it is long enough, an individual will tend to be bored and learning becomes disrupted (Aulia et al., 2020). Media Flowchart shortening students' time to build quality understanding due to the effectiveness of material absorption. An interactive learning medium gives individuals control over their own learning pace. Thus, interactive multimedia combined with Flowchart will present learning information that is not only fun, interesting, and easy to understand in clarity (Kustyarini et al., 2020) but also improve active learning. Flowchart presented in infographic elements, helping students to visualize their thoughts. This is in line with the stages of cognitive process, one of the stages of which is through systematic procedural thinking (Zhang, Meng, Zou, Zhu, &

Hwang, 2023). Further in research (Zhang et al., 2023), Flowchart with a progressive approach proven to effectively improve cognitive strategies and knowledge absorption in the field programming. In the study, students were asked to explain the procedural meaning of each stage Flowchart. This enriches the reflective learning experience of students. The presence of inclusivity and personalization of Flowchart Interactive Enriches Learners' Learning Experience (Boon, 2024). At Flowchart Students absorb information more optimally compared to text. Because, on Flowchart Students learn in stages that are sequential or cannot be skipped through. This makes students to keep learning and even learn through repetition. This condition improves the quality of memory retention and self-efficacy. From this process, Flowchart interactive has an impact on improving abilities self-regulated learning (Jack Li, 2022). With reflective and procedural learning, the stages of Flowchart Facilitate Self-Monitoring during the learning process of students. AI chatbots also provide space for the existence of features Self-Monitoring Monitoring. This is very helpful in the stages self-regulated learning. On the other hand, Monitoring is a key stage of SRL's success. Individuals with good academic achievement, emphasizing more learning strategies on the process Monitoring compared to other stages (Geng & Su, 2025). Chatbots also provide an inclusive and fun learning experience that can increase individual participation (Adiguzel et al., 2023; Ahmad et al., 2023; Kooli, 2023)

CONCLUSION

Based on the results of a literature review, interactive multimedia flowcharts assisted by AI chatbots are relevant learning innovations to face the challenges of the Smart Society 5.0 era. Interactive flowcharts help students organize ideas and visually monitor their learning progress, while AI chatbots provide adaptive interactions that facilitate reflection and self-monitoring. The collaboration between the two strengthens the cognitive, metacognitive, and motivational aspects of students in developing self-regulated learning skills. Theoretically, the use of this media is in line with the AI in Education paradigm which places artificial intelligence as a learning collaborator. Practically, this innovation can be applied as a supporting medium for independent learning and blended learning in higher education. However, ethical aspects, data privacy, and equal access to technology need to be a concern in its implementation. This study also identified a research gap in the form of limitations of empirical research that tested the effectiveness of the combination of flowchart media and AI chatbots on SRL in the context of Indonesian education. Therefore, further research needs to be directed at the development of experimental learning models and empirical measurement of their influence on aspects of student planning, control, and self-reflection.

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