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Metacognitive Skills As A Guidance Curriculum In The Age Of AI

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ABSTRACT

The existence of Artificial Intelligence (AI) in educational practice should increase mobility and learning outcomes and improve student learning skills. On the other hand, students see AI as a system that helps them complete practical learning tasks. This condition creates a conflict and a dilemma in using AI in learning. Studies on AI in education recommend metacognitive as an essential ability for students to utilize AI well. The research aims to find the formulation of the metacognitive competencies students need in using AI as content in curriculum guidance. The research method uses the Systematic Literature Review with the PRISMA model. The literature review results show that metacognitive studies in adolescent education and development refer to longitudinal studies conducted by Roger Azevedo. Guidance curriculum in improving metacognitive skills related to the use of AI are 1) self-regulation, 2) critical thinking, and 3) decision-making process. Guidance activities that can be carried out in developing metacognitive must be inquiry – oriented such as pair activity (brainstorming), self-assessment, experiential activity, and information selection.

Keywords: metacognitive, guidancance curriculum , artificial intellegence

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INTRODUCTION

Artificial intelligence (AI) has developed rapidly in the last decade. The development of AI is in line with the creation of various applications, from microcomputer chips to the Internet of Things. Innovation and enhancements to features, functions, and appearances make this technology increasingly utilized and impact human life. AI refers to computer programs designed to adapt human intelligence so that the program can adequately perform certain activities. Recent technological developments enable AI to perform decision-making, logic, and other characteristics of intelligence. Like a search engine, it only works to search for words at first; then, at this time, it can predict sentences that will be searched and even recommend interesting topics to read.

The era of AI is when various activities are currently assisted and even replaced by AI programs. In the context of disruption, AI becomes a game changer in today's life and the future. The development of AI can potentially create massive changes in how we act and live our daily lives. In the learning process, AI impacts cognitive capacity and helps students to engage in critical thinking. (Kitsantas et al., 2019). AI technology can quickly analyze large amounts of data beyond standard human capabilities, provide recommendations, and even make day-to-day decisions that will undoubtedly change how we live (Shaw, 2019; Srivastava, 2023). These conditions are supported by human needs, which sometimes experience moral dilemmas in making decisions or lack adequate information, making it challenging to find options in a short time (Roe et al., 2022). However, AI's role is still being debated, especially in ethical issues.

Today AI is starting to take a role in learning activities in schools and universities. AI facilitates quality improvement in learning tools such as MOOC (Massive Online Learning Courses) (Fauvel et al., 2018; Yu et al., 2017), intelligent tutoring system (Haridas et al., 2020), T-bot (teacher bot) (Bozkurt et al., 2018; Pillai et al., 2023), and other applications. Chatbots used to provide student services and learning support are one form of AI that is starting to emerge in educational institutions (Khare et al., 2018).

The existence of AI in education is a disruptive phenomenon in learning. Since 2022, GPT Chat has become a famous AI students use in learning. Wibowo et al. described that generally, students use AI to find answers to questions given by the teacher, posing a threat to creativity, innovation and decreasing motivation to learn. Shidiq (2023) emphasizes that there is a threat to student learning creativity in line with the use of GPT Chat, and this is a challenge for the learning process that is created. The results of a literature study show that the use of ChatGPT in education has a positive side in completing tasks but requires assistance, guidance, and direction so as not to make students think less, write critically, and feel lazy by only copying and pasting search results (Ramadhan et al., 2023).

In this regard, the significant role of educators is in mediating and supporting student self-determination and motivation in AI-based learning (Chiu et al., 2023). Most of the research debates the ethics of using AI in learning. According to researchers, students can use AI ethically in learning based on meta-cognitive skills, such as critical analysis, evaluation, and decision-making.

Metacognitive skills are needed so that students can be independent and critical in understanding any information provided by technology (Faiz & Kurniawaty, 2023). Metacognitive skills must be possessed so students can utilize AI effectively and efficiently. As found by Braad et al. (2022) that students with high metacognitive skills are better able to choose AI that is relevant to learning. Thus the main problem that makes students use AI unethically and has no impact on learning performance is low metacognitive skills.

Guidance and counseling need to play an active role in developing metacognitive skills to support student achievement. The role of guidance and counseling in the AI era is to help students develop habits in safely accessing the digital world (digital citizen), namely understanding and evaluating the information obtained to make good decisions (Anggraeni, 2017). Casmini tates that in developing guidance and counseling programs, guidance content must adapt to the skills needed in the era of society 5.0 and digital transformation, namely critical thinking, cognitive adjustment, creativity, self-regulation, and decision-making. These skills are related to meta-cognitive skills.

Research related to metacognitive development has been carried out in this decade. However, it focuses on the teacher's role in learning, while guidance efforts, especially curriculum guidance, have yet to appear in this research. Therefore this research will involve a framework of metacognitive skills as content in curriculum guidance to help student achievement in the AI era.

METHODOLOGY

The study was conducted to answer two research questions, namely 1) what metacognitive skills are needed by students in the era of AI as curriculum guidance content (RQ1), and 2) what strategies are relevant in developing metacognitive skills (RQ2). A systematic literature review method was used to answer the two research questions. The research began by tracing the literature in the database dimension as a platform capable of combining bibliographic data with citation data, thus enabling a more comprehensive and integrative bibliometric analysis. The search used the keyword "Developing metacognitive skills" based on the title and abstract. The literature traced is research articles from the past five years, assuming that in 2019 there will be much research in the field of education that examines online and AI-based learning. Next, the researcher conducted a screening to obtain reliable literature and met the criteria. Table 1 below describes the criteria used by researchers in determining literature which is the primary data source (inclusion criteria).

Table. 1

Inclusion Criteria

NO	FILTERS	CRITERIA
1	Years	2019-2023
2	Type	International Publication Journal / Proceeding
3	Research Fields	Psychology, Pedagogy, Psycho-education
4	Approach	AI phenomenon in formal education (school, universities, collages, etc.)

The procedure for selecting literature as research data uses the PRISMA model. The flow of determining literature based on a systematic literature review using the PRISMA model is illustrated in the Figure.1 below.

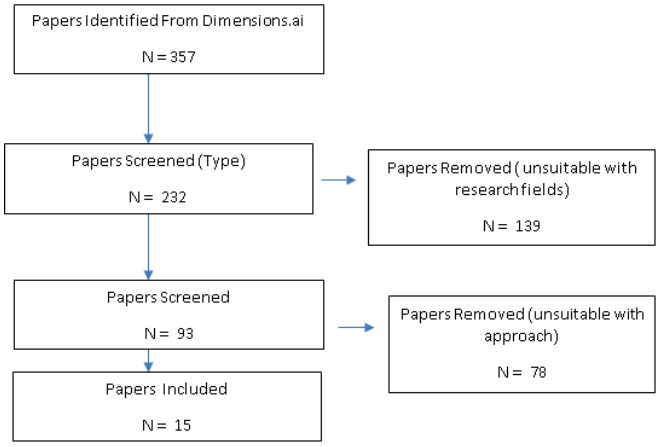

Figure 1.
SLR Scheme

The data analysis tool uses Vosviewer to visualize and explore the bibliometric knowledge map. The visualization produced by VOSviewer allows researchers to identify trends, gaps, and previous research contributions more efficiently. In this study, the mapping used is co-citation and co-occurrence.

RESULT AND DISCUSSION

literature search using dimensions.ai shows 357 publications related to rmetacognitive skills. After screening according to the criteria in Table 1, 15 publications were determined to be included and used as the primary research data. Most publications were eliminated because they needed to be suitable with field

research and approach. They focused more on metacognitive in the context of AI technology and metacognitive in the context of mental health. Selected literature discusses metacognitive development in learning at the age of AI. Table 2 describes each selected literature (included) as a study of this research.

Table. 2

Paper Included

No	Author, Years	Title	Summary
1.	(Crompton et al., 2020)	Psychological Foundations Of Emerging Technologies For Teaching And Learning In Higher Education	Technology has an impact on the cognitive and social-psychological processes that occur during the teaching and learning process
2.	(Niemi, 2021)	AI in learning: Preparing grounds for future learning	AI supports cognitive and non-cognitive learning processes, but there needs to be a combination and integration of AI with human learning needs
3.	(Chen & McDunn, 2022)	Metacognition: History, Measurements, And The Role In Early Childhood Development And Education	Metacognition is an essential skill for academic achievement, especially problem-solving amidst the development of the internet and the gradual promotion of online collaborative learning.
4.	(Wiedbusch et al., 2023)	A Multi-Level Growth Modeling Approach To Measuring Learner Attention With Metacognitive Pedagogical Agents	The metacognitive monitoring information in this model impacts learner behavior and the regulation of effort and attention.
5.	(Kitsantas et al., 2019)	Intelligent Technologies To Optimize Performance: Augmenting Cognitive Capacity And Supporting Self-Regulation Of Critical Thinking Skills In Decision-Making	AI-based systems can reduce cognitive load and create simplified versions of problems. Then, users are expected to be able to carry out more challenging cognitive processes, such as conducting critical analysis and making decisions based on the data presented by AI.
6.	(Lara Nieto-Márquez et al., 2020)	Digital Teaching Materials And Their Relationship With The Metacognitive Skills Of Students In Primary Education	Higher use of logic and spatial activity is related to metacognitive knowledge. The research results have implications for the importance of metacognition assessments and improving digital materials to stimulate students' metacognition.
7.	(Ogino et al., 2019)	A Sustainable Training Method Of Metacognitive Skills In Daily Lab Activities Using Gaze-Aware Reflective Meeting Reports	Reflective Meeting Reports are used as a sustainability learning activity. It is possible to produce opportunities for learners to become aware of cultivating their metacognitive skills.
8.	(Zhou & Lam, 2019)	Metacognitive Scaffolding For Online Information Search In K-12 And Higher Education Settings: A Systematic Review	Teachers must accompany students in searching for information online and facilitate the "inquiry process," such as sourcing, evaluating, synthesizing, and supporting the task.
9.	(Usman et al., 2021)	The Contributions Of Metacognitive Skills Towards The Retention Of Different Academic Ability Students For The Implementation Of Several Learning Models	The READS learning model can improve metacognitive skills, including Reading, Exploring, Answering, Discussing, and Summarizing.
10.	(Muthmainnah et al., 2022)	Playing With AI To Investigate Human-Computer Interaction Technology	AI-based teaching helps students learn critical thinking skills and increases students' confidence, self-confidence, open-mindedness,

No	Author, Years	Title	Summary
		And Improving Critical Thinking Skills To Pursue 21st Century Age	and maturity in thinking. AI-based learning instructions emphasize human and computer interaction through virtual simulations, discussion platforms, game-based learning, etc.
1	(Bataeva, 2019)	Cognitive And Metacognitive Skills Of Students In The Context Of Smart-Education	Self-control and self-monitoring of learning effectiveness are essential aspects of the success of smart learning. This activity is part of the metacognitive process that needs to be conditioned by teachers and students.
1	(Damayanti et al., 2021)	The Role Of Metacognitive Skills In Developing The 21st Century Skills	Metacognitive skills as a factor in students' success in mastering 21st-century abilities consist of problem-solving, critical thinking, reflective thinking, and accessing information.
1	(Nafi'ah et al., 2022)	Metacognitive Skills Of Junior High School Students In A Pandemic Period Based On The Enriched Virtual Model Of Pjbl	The role of metacognition in Virtual PJBL activities is to plan, monitor and evaluate thoughts related to teaching material
1	(Burkhard et al., 2021)	Paradigm Shift In Human-Machine Interaction: A New Learning Framework For Required Competencies In The Age Of Artificial Intelligence?	Today's students must also be decision-makers and have the knowledge, skills, attitudes, and values to recognize opportunities and dangers in using AI. In this way, they can increase the personal capacity needed in the future.
1	(Azevedo, 2020)	Reflections On The Field Of Metacognition: Issues, Challenges, And Opportunities	Metacognition occurs when students always reflect on previous learning. They assess the ease, effectiveness, efficiency, and risks of using AI in their learning process. Activities related to this metacognitive process include screen recording, detecting, tracking, scaffolding, think-aloud, and eye-tracking.

Based on the literature, the researcher conducted a co-citation analysis of the authors to ensure that the most cited author is the primary reference for researching metacognitive learning. The results of the analysis are presented in Figure 2 below.

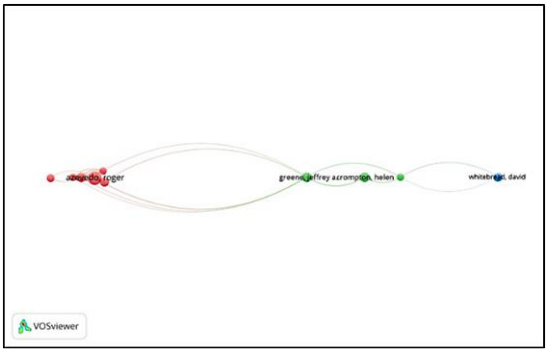

Figure 2.
Co-Citation Analysis

Based on the analysis results, it was identified that Roger Azevedo was the author with the most citations related to metacognitive learning. Azevedo is a researcher and lecturer at the University of Central Florida who is actively researching metacognitive issues and self-regulation, which was conducted longitudinally more than ten years ago. These issues are comprehensively researched, both conceptually meta-cognitive and self-regulation in learning, and they are related to digital learning, hypermedia, to the AI era as it is today.

Furthermore, the study conducted a co-occurrence analysis to answer RQ 1 by mapping terms that always appear related to metacognitive development, especially in the context of learning in the AI era. The co-occurrence results are presented in Figure 3 below.

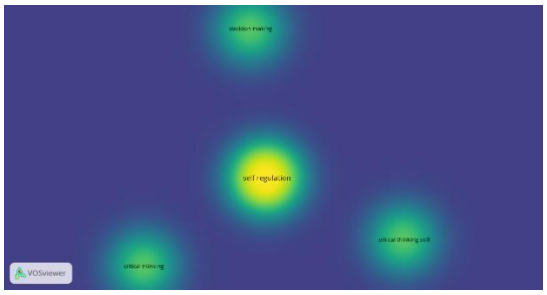

Figure 3.
Co-occurance Analysis

The results of the research in Figure 3 show three essential metacognitive skills that must be present in the guidance curriculum in the age of AI 1) self-regulation, 2) critical thinking, and 3) decision-making. The three skills obtained based on the results of a systematic literature review are described in Table 3 below.

Table 3.

Metacognitive skills in The Age of AI

No	Domain	Description	Author, Years
1	Self-Regulation	Skills to organize, monitor the learning process, using resources (AI) with learning objectives or syllabus, and selecting main ideas. This skill helps students in setting goals and materials needed, organize learning activities, manage time, map assignments, and learning strategies to be carried out. Self-regulation arises when a person reflects on the findings (AI output) in the context of thinking/learning material they have.	(Azevedo, 2020; Bataeva, 2019; Chen & McDunn, 2022; Crompton et al., 2020; Kitsantas et al., 2019; Lara Nieto-Márquez et al., 2020; Nafi'ah et al., 2022; Niemi, 2021; Ogino et al., 2019; Usman et al., 2021; Wiedbusch et al., 2023; Zhou & Lam, 2019)
2	Critical Thinking	The skills to interpret, analyse, assess, infer, and explain information obtained by AI. This skill has an impact on performance in information retrieval. Critical thinking requires systematic thinking to identify and assess weaknesses or strengths in learning outcomes so that they can plan and solve problems. A critical attitude makes students able to determine reliable information, decisions, and actions.	(Azevedo, 2020; Muthmainnah et al., 2022; Nuryati et al., 2021; Zhou & Lam, 2019)
3	Decision Making	The skills to make meaningful and critical decisions are	(Azevedo, 2020; Burkhard et al., 2021;

No	Domain	Description	Author, Years
		based on lots of data obtained. Decisions related to problem-solving are carried out in harmony with the context and learning objectives. Meaningful decisions occur when students can reflect on and explain the decisions they take (responsibility).	Nafi'ah et al., 2022; Niemi, 2021)

Based on Table 3, the researchers identified essential activities related to metacognitive skills in the AI era: evaluation and monitoring, interpretation and analysis, and self-reflection. They become a reference in answering RQ2, a metacognitive development strategy. Azevedo (2020) emphasized that the challenge in metacognitive development is the metacognitive emergence of nuances and instructions given to guidance or learning activities. In this regard, a relevant design that appears frequently in studies is inquiry-oriented (Muthmainnah et al., 2022; Niemi, 2021; Usman et al., 2021; Zhou & Lam, 2019). In guidance or training activities, the workflow is framing the problem to be solved, tracking using AI, providing feedback, and reflecting on the steps to be taken based on the data provided by AI. The formulation used is re-examining, reasoning, and reflection (Spector & Ma, 2019).

Goodrich et al. (2020) stated that counselling services in schools that are digitally responsive play a role in increasing awareness and solving student problems that arise in the virtual world. One of the roles played by school counselling is to compile a guidance curriculum that contains metacognitive skills so that students can prevent and solve problems related to the use of AI. Alternative activities that can be carried out in metacognitive development include pairing activities (brainstorming), self-assessments, experiential activities, and information selection (Lara Nieto-Márquez et al., 2020). The school counsellor plays a role in providing feedback in metacognitive training sessions. The emphasis on feedback is exploration and reflection on what is known, what is thought, and what is right to do with these AI technologies. At the same time, feedback can help students organize their learning and strengthen AI engagement towards achieving learning goals.

The implementation of metacognitive development activities in counselling services at school, one of which is by using case studies or focus group discussions related to AI that are relevant to students' lives. For example, discussing the ethics of using AI-generated content and encouraging students to consider various perspectives and consequences. Students also reflect on their AI usage habits, identifying strengths and risks, such as dependency or misinformation. In addition, AI can also be used as a guidance medium in group guidance. Students are challenged to design solutions to a social problem and are allowed to use AI to dig up the information needed. In the guidance session, students are encouraged to assess the information obtained, such as the credibility and accuracy of the information and its suitability to the context of the problem discussed in the group guidance. This exercise fosters students' critical thinking. The feedback provided by the counsellor will guide students in the process of self-discovery, not just providing answers. By encouraging students to articulate reasoning and reflect on their cognitive processes, counsellors empower them to develop the metacognitive and decision-making skills needed in the increasingly complex AI era.

CONCLUSION

The literature review results show metacognitive skills as a guidance curriculum in the age of AI are 1) self-

regulation, 2) critical thinking, and 3) decision-making process. Guidance activities that can be carried out in developing metacognitive must be inquiry – oriented such as pair activity (brainstorming), self-assessment, experiential activity, and information selection.

The development of these skills is attempted through group guidance activities. Guidance is carried out in the form of focus group discussions or case studies. The use of AI is allowed in guidance sessions. An important experience that is built is that students reflect on and assess how to use AI, the ethics of its use, the accuracy of the information, and the appropriateness of the information to the context of the situation being discussed. Counsellor feedback guides students in finding their answers, not just providing them with answers. By encouraging students to explain their reasons and reflect on their thinking processes, counsellors equip them with metacognitive and decision-making skills.

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