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Exploring Awareness of Using Generative AI in Higher Education Through Metacognitive Strategies

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Annotation. The purpose of this study is to explore metacognitive awareness of using generative AI (GenAI) in higher education through metacognitive strategies. The results reveal students' task-specific manner in using GenAI and highlight the drivers of GenAI application among students. Students' metacognitive awareness of GenAI application in the learning process is evident in terms of metacognitive knowledge and regulation; however, students lack sufficient planning and evaluation skills.

Keywords: *GenAI, higher education, metacognition, metacognitive awareness.*

Introduction

The emergence of generative artificial intelligence (GenAI) has not simply introduced digital tools supported with AI into higher education, but challenged long-lasting understanding of what counts as learning, academic curricular, authorship and responsibility over the learning process and learning outcomes. On the one hand, GenAI is considered as a potentially valuable learning assistant because it can support students through explanations, immediate feedback, and more efficient progress towards achieving learning goals (Kasneci et al, 2023; Sinhaliz et al., Burdjaco, &

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Du Preez, 2023). On the other hand, there is doubt that the same affordances can undermine academic integrity, especially when GenAI is used to replace rather than support students' own cognitive work (Korn & Kelly, 2023). These different positions create tension and frustration, but they should not be treated as mutually exclusive. The question is not whether GenAI should be accepted or rejected in general, but how students can distinguish its appropriate assistance from harmful and ill-purposed use. Since GenAI is becoming a part of students' future professional environment, avoidance is not a suitable solution nor a sustainable educational response to the challenges posed by academia.

This tension can be addressed by clarifying the conditions under which GenAI supports learning rather than weakens it. There are multiple ways to research how learning processes and teaching methods need to change, and there are multiple recommendations for how GenAI can be used ethically without raising too many challenges to teachers and students. However, there is a high need to explore how much students are metacognitively aware of the use of GenAI for their studies and to what extent they use their cognitive knowledge for metacognitive monitoring and control in academic task comprehension and performance. In simple words, this would mean clarifying whether students understand why, when, and how GenAI should be used in relation to their learning goals and task performance. Higher education teachers need to know whether students are metacognitively aware of their GenAI use and whether they apply cognitive knowledge to monitor and control their academic task comprehension and performance.

Metacognitive competencies are highly relevant for contemporary learners because they connect the application of the tool with self-regulated decision-making. Their development is closely tied to individuals' ability to apply metacognitive skills (Hutson et al., 2023), which, in this context, can help to develop a new approach among higher education teachers and students, allowing responsible use of GenAI. Metacognitive knowledge may help the learner to establish metacognitive awareness about his or her learning strategies with GenAI tools and to manage this awareness as personal cognitive knowledge, becoming procedural and then strategic knowledge, which is needed to make decisions when and how to interact with the GenAI tools (Flavel, 1979; Schraw et al., 2006; Donker et al., 2014; Elsayary, 2024). Mastering metacognitive components such as metacognitive awareness and management of cognition, including knowledge, abilities, and attitudes needed for student self-reflection on GenAI usage for learning, would allow them to take control of their learning with GenAI and the ability to regulate and coordinate their own learning process and its outcomes. Metacognitive knowledge helps learners to understand their strategies, limitations and goals when interacting with GenAI tools; therefore, metacognition is not only a general skill but also a mediating capacity that allows students to evaluate their role and the role of GenAI in their own learning. The knowledge about oneself as a learner can support more independent and

conscious use of digital technologies, whether for self-learning or university studies in general (Drigas et al., 2023). Cognitive regulation through metacognitive competences allows students to identify and select the appropriate strategies to allocate GenAI tools as resources for their learning while remaining aware of task comprehension and performance. Thus, measuring students' metacognitive awareness of GenAI use can provide insight into students' cognitive knowledge and cognitive regulation, learning strategies, and learning outcomes (Flavel, 1979; Whitebread et al., 2009; Vrugt & Oort, 2008). This research therefore aims to explore students' metacognitive awareness of using GenAI in higher education through metacognitive strategies.

Previous studies have already examined the impact of GenAI on students' learning process, academic performance and ethical considerations, but their findings also reveal why a metacognitive perspective is needed. Abbas et al. (2024) explored positive and negative effects of using GenAI among university students. They found that academic workload, time pressure to deliver the task, and students' sensitivity to rewards increase the use of ChatGPT, while sensitivity to the quality of developed content does not. These findings are important because they suggest that students' GenAI use may be driven more by external pressure and instrumental benefit than by critical evaluation of learning improvement with GenAI.

Chan and Hu (2023) emphasize students' own perceptions of GenAI technologies and identify challenges of GenAI use, such as data accuracy, transparency, ethical issues, and the development of holistic competencies. Delcker et al. (2024) further indicate that students' intention to use GenAI is influenced by their skills, knowledge, and attitudes. Taken together, these studies show that student engagement with GenAI is shaped by both pressure factors and competence factors. Research on awareness may explain not only whether students use GenAI with awareness, but how they judge when to use GenAI and if they regulate that use.

Theoretical Background

The concept of metacognition provides a useful theoretical lens because it focuses on the learner's awareness and control of one's own cognition. Flavell defined metacognition as "cognition about cognitive phenomena", often simplified as "thinking about thinking" (Flavell, 1979). However, in the context of GenAI, this definition needs to be applied more critically. Students are not only thinking about their own thinking, but they are deciding how much of their thinking may be delegated, supported or reshaped by an external intelligent system. Metacognition, according to Flavell (1979), consists of two complex components: metacognitive knowledge and metacognitive regulation. These two components are particularly relevant in this case. Metacognitive knowledge refers to the knowledge about cognitive processes and the knowledge used

to control these processes (Livingston, 2003). Different studies show that metacognitive knowledge can affect and improve performance (Brown, 1987; Garner & Alexander, 1989; Flavell, 1987). Yet knowledge is not sufficient. Metacognitive regulation refers to monitoring a person's cognition, which includes planning, monitoring and evaluating learning processes and strategies, as well as determining whether learners can apply that knowledge in practice (Schraw & Moshman, 1995). In relation to GenAI, this distinction means that students need not only awareness of what GenAI can do, but also regulatory capacity to decide whether its use supports learning.

The polarity of perceptions, arguments, and effects of the application of GenAI tools has recently created chaos in higher education (Lim et al., 2023). This chaos and differences in regulation of the use of GenAI in higher education can be seen in policy responses: some US universities, New York state's government, several Australian regions, and Italy issued policies banning student use of GenAI for assessment, while some professors continue encouraging students to use it for learning or even assessment (Lukpat, 2023; Lim et al., 2023). These opposing positions reflect different assumptions about risk and educational value. Prohibitive approaches prioritize academic integrity but may ignore the reality that GenAI is already actively used by many students in higher education (Abbas et al., 2024; Von Garrel & Mayer, 2023). However, there are still students who avoid using GenAI as they fear negative consequences that would keep them away from academic support and integrity (Chan & Hu, 2023). Metacognition and metacognitive strategies can help to solve this problem by supporting ethical and responsible use of GenAI among students (Mason et al., 2023).

Metacognitive awareness, once applied, would help students oversee and purposefully guide their learning process (Dahri et al., 2024), making them reflect on themselves as learners, their knowledge about learning strategies, and the chosen instruments, which would result in managing their learning and improving the learning process with the help of metacognitive strategies (Rahimi & Katal, 2012). In this way, metacognitive awareness would contribute to purposeful learning with GenAI (Biggs, 2003). The consciously chosen learning strategy is therefore a vital condition for purposeful and aware learning (Rahimi & Katal, 2012). In this sense, the application of metacognitive strategies using GenAI requires a more complex understanding of AI: learning about AI, learning with AI and applying AI ethically.

Patterns of GenAI Application

Recent studies show that students use GenAI for a wide range of academic purposes, but these purposes differ to a great extent. Von Garrel and Mayer (2023) found that more than two-thirds of students actively used GenAI during their studies, and the most common purpose of it's use was to clarify or explain subject-specific questions. Such use would resemble tutoring, explanation, feedback provision and thus could be interpreted as learning-supportive use of GenAI. However, the same research showed

that GenAI is also widely used for literature reviews, text translation and content creation (Von Garrel & Mayer, 2023). These purposes open more complex interpretations because they may either support learning or replace student cognitive processes with a machine thinking process. Therefore, the frequency of using GenAI would not explain nor clarify the benefits or shortcomings of using GenAI. The use of GenAI should be evaluated according to the role that GenAI plays in task implementation.

Research findings by Johnston et al. (2024) demonstrated that students actively apply GenAI tools for grammar and spelling checks, concept understanding, and text summarization (Johnston et al., 2024). These functions may support lower-level cognitive processes, such as revision and comprehension, but they can also reduce students' engagement with language and even higher-order cognitive skills, such as synthesis and evaluation, which will be skipped if cognitive processes stay passive during the use of GenAI. Chan and Hu (2023) claim that GenAI tools are also used by students in learning for brainstorming ideas, audio and visual content creation (from image or audio generation to creating a full presentation or video), research and data analysis support. Their findings suggest that students value GenAI because it provides personalized and immediate learning support, enhances creativity, assists writing, and supports research and analysis. In comparison, Abbas et al. (2024) highlight that students use GenAI for offloading because of academic workload and time pressure (Grinschgl & Neubauer, 2022). These findings suggest different important purposes of GenAI use, which may extend student thinking but may also be used to avoid cognitive effort. The differences are in students' decisions and metacognitive awareness of using the tool.

Challenges and Added Value

Academic integrity remains as the most prominent concern regarding the use of GenAI. The disruption of academic integrity is often evidenced by cheating, plagiarism, and misuse. Recent research shows that 89% of American students use ChatGPT for their studies, 53% use it for academic writing, and 48% use it during exams (McGee, 2023). Sullivan et al. (2023) argue that GenAI in higher education is more commonly used for cheating rather than for learning. These claims cannot be ignored, but they also need critical interpretation. They show that assessment practices and academic integrity policies are under pressure. Metacognitive awareness of students is of high relevance in addressing these challenges. Students should learn metacognitive skills to be able to evaluate the ethical and cognitive consequences of the use of the tool.

The second major challenge is overreliance on GenAI and dependence upon the tool. Overreliance on GenAI support also affects learning outcomes and students' thinking skills development. The research conducted by Chen et al. (2020) showed that GenAI-driven tools which aim to assist students in their writing can prevent students from developing writing skills, because proof-checking in this case is mainly performed by the tool; thus, students do not learn from their mistakes. Immediate

feedback significantly improves learning, but only when students consider it and compare their own text with the revised output. If GenAI feedback is accepted without reflection, it may reduce learning efficiency because students will accept revision without metacognitive knowledge evaluation and regulation phases. The consecutive learning process will then increase the gap between initial knowledge and later revision cycles and will increase students' dependence upon the tool decisions.

It is often the case with the application of technologies in education that random and ill-purposed application creates more challenges than it brings added value for learning. Purposeful application of GenAI can create considerable added value for students and teachers in higher education. From the student's perspective, GenAI can function as a personalized tutor that helps students to deal with complicated subject-specific content, ask questions, clarify information, seek immediate feedback and adapt explanations to preferred academic styles (Chan, 2023; Łodzikowski et al., 2023). These examples illustrate that the added value of GenAI use for learning is a strong argument against unregulated and unreflective use of the tool, rather than prohibitive policies.

Accessibility is another important area in which GenAI creates added value to the learning process (Holmes, 2023; Yusuf et al., 2024). GenAI may make learning more accessible by helping students access additional resources, search for information in other languages, translate resources and use assistive tools that convert spoken language to text or text to speech. Teachers can also benefit from the use of GenAI when preparing their lessons, searching for learning and teaching resources and many other ways (Lim, 2023; Moorhouse & Kohnke, 2024). Some researchers argue that GenAI can significantly reduce teachers' workload, improve efficiency, save time and provide unbiased and objective results (Tobler, 2023). Some of these arguments need accurate interpretation and further research, as efficiency does not automatically mean better teaching and learning. However, these claims foster further considerations when and how GenAI can be integrated so that it improves accessibility and extends support for teachers and students.

For these reasons, higher education institutions need guidelines for students and educators on how GenAI should be used in teaching and learning. However, such guidelines and recommendations should be grounded in research with practical applicability and students' actual awareness during the decision-making process. This research applies the theory of metacognition to explore student metacognitive awareness of using GenAI and to describe the role of metacognition in measuring such awareness among students. The argument in this research states that metacognitive competences and AI competences should be developed in education together: students need to understand GenAI as technology, but they also need to regulate how it affects their comprehension, effort, authorship, and learning outcomes. Metacognitive competences should therefore help students to identify the most beneficial and responsible ways of applying GenAI for learning (Lim et al., 2023).

The aim of the Study

This study aims to explore metacognitive awareness of using generative AI (GenAI) in higher education through metacognitive strategies. The study is based on two research questions: 1) In which ways and for what purposes do students use GenAI in higher education? 2) What is the role of metacognition in measuring awareness of the application of GenAI in the learning process? The aim of the study was achieved through the following objectives: a) identifying the patterns of application of GenAI that reveal students' specific manner in using it for learning, b) discussing the drivers that engage students in application of GenAI based on the nature of the task, as well as c) describing the levels of awareness of students about the purpose and the way they use GenAI in higher education.

Research Methods

The theory of metacognition was used as the main research paradigm for the study. The qualitative research method was used to get a better understanding of the ways people experience phenomena, their attitudes towards them, and their behavior (Pathak et al., 2013). It helps to receive more complex and in-depth answers to "how" and "why" questions within people's experience of phenomena (Oranga & Matere, 2023).

Considering the theoretical findings on the patterns and the causes of GenAI use in higher education, semi-structured interviews were employed. Semi-structured interviews were applied as they are best suited to answering the research questions. According to Magaldi and Berler (2020), semi-structured interviews ensure an explanatory yet guided approach. They allowed the use of the framework of themes from the theoretical findings to be explored and, at the same time, to prompt reflection and identify implicit thinking patterns that might not come up spontaneously. The instrument was constructed following a consistent approach with the theoretical part, ensuring that instrument statements are aligned with the metacognitive elements (see Table 1). Open-ended questions are supposed to give participants space to share their experience about the application of GenAI in their learning process and provide an opportunity to reflect on the main motives behind its application and awareness about the process and their authentic knowledge.

The interviews were conducted among fifteen Bachelor, Master, and PhD students of different faculties in Lithuanian, Spanish, Swiss, and Ukrainian universities. The invitation to participate in the research was sent out to student groups in the universities where one of the authors of this research resided during the study years. Personal contacts were used to forward the invitation to classmates via group channels. The students who were invited to participate in the interview had to have experience using GenAI for learning and had to be willing to give an interview about their experience on a voluntary basis.

The interview instrument consisted of 13 open-ended questions organized around two dimensions: the patterns and drivers of GenAI use, and the metacognitive elements of Flavell's (1979) framework – namely, metacognitive knowledge (knowledge of oneself as a learner, procedural knowledge, and conditional knowledge) and metacognitive regulation (planning, monitoring, controlling, and evaluation). Each question was designed to elicit reflective accounts of students' decision-making processes when using GenAI, rather than simple descriptions of behavior. Where needed, additional clarifying probes were used to encourage deeper reflection and to surface implicit awareness that participants might not have articulated spontaneously. Metacognition was used as the background theoretical approach also to structure the instrument itself, so that the design and the sequence of the interview questions allowed measuring participants' awareness as well.

Table 1

Statements and Questions

Statement	Question	Metacognitive element
General knowledge of what GenAI is and understanding how it is integrated.	1. How would you describe GenAI? How do you think GenAI is represented in your learning process?	Knowledge of oneself as a learner
Development of metacognitive skills helps students to be aware of how and why they use GenAI in their learning.	2. Could you walk me through the steps you take when deciding whether to use.	Planning
	3. GenAI for a learning task? What affects your decision whether to use GenAI or not?	Procedural knowledge
	3.1. How does GenAI usage in your learning process align with your learning objectives (things you need to learn)?	Conditional knowledge Planning
To make sure that GenAI usage is purposeful, there is a need to align learning activities with the learning outcome that is expected to be achieved.	4. How aware are you of the role of GenAI in achieving your learning goals?	Monitoring
	4.1. When you use GenAI for your learning task, do you reflect on how much it works for your abilities to implement the task?	
	4.2. How much of the learning task/ assignment is implemented by you and by GenAI? Could you share an example of when you used GenAI and it helped you to do the assignment?	Knowledge of oneself as a learner
	5. How much do you think about your abilities to reach learning goals, with or without GenAI?	Planning
	5.1. What is the role of GenAI in reaching your learning goals?	

Statement	Question	Metacognitive element
Students use GenAI to enhance their creativity.	6. How do you reflect on the influence GenAI has on your creativity while doing your academic tasks? 6.1. Can you provide an example when you consciously use GenAI to do your learning task? Can you provide an example of when you decided not to do it?	Monitoring
Students use GenAI to receive assistance in writing.	7. How aware are you of the influence GenAI has on your writing skills?	Monitoring
Students use GenAI to receive learning support.	8. How effective do you think GenAI is as a learning tool? 8.1. What specific strategies do you use to evaluate the quality and impact of the support it provides in your learning?	Evaluation
Students use GenAI due to academic workload and time pressure.	9. When you face academic workload and time pressure within your studies, how do you decide if you use GenAI tools? 9.1. How do you make sure that its use remains purposeful (only as a supporting tool, but not solving academic tasks for you)?	Conditional knowledge Controlling
One of the main concerns of GenAI application in higher education is unethical academic behaviour.	10. How do you know that you ethically use GenAI? Could you give an example of when you used it ethically and when not?	Controlling
Students tend to over-rely on GenAI tools in their learning.	11. To what extent do you rely on GenAI applications in your learning?	Controlling
The development of AI competencies is essential for the purposeful application of GenAI in higher education.	12. How would you describe your competence in using GenAI in learning? 12.1. What skills have you developed to improve your experience in GenAI application for learning?	Knowledge of oneself as a learner Procedural knowledge
GenAI tools can make learning more accessible.	13. To what extent do you think GenAI tools are used by learners as a supporting tool? Do you feel safe using GenAI tools which are accessible to any user online?	

This study originated as a master's thesis project. A purposive sampling approach was used to include participants who had direct experience with the topic studied. Participants were invited based on their availability and willingness to take part in this research. Although participants were from four different countries, nationality was not a selection criterion, and the study did not aim to compare national contexts.

The following criteria were applied to select research participants:

- Bachelor, Master, or PhD degree students in higher education having at least 0,5 years of experience using GenAI in their learning process

Fifteen participants took part in this research. The interviews were conducted online via Zoom, in 4 weeks among Bachelor, Master, and PhD students of different faculties in Lithuanian, Spanish, Swiss, and Ukrainian universities. Each interview lasted from 30 to 40 minutes.

CryptoAI program was used for the transcription of the records of the interviews. The interviews were conducted in English.

Table 2

Demographic Information on Participants

Code	Place of studies	Field of study	Cycle
S1	University of Jaen	Humanities	Bachelor
S2	Vytautas Magnus University	Social science	Bachelor
S3	Pädagogische Hochschule Luzern	Social science	Master
S4	Vytautas Magnus University	Humanities	Bachelor
S5	Vytautas Magnus University	Social science	Master
S6	Vytautas Magnus University	Social science	Master
S7	Vytautas Magnus University	Social science	Master
S8	Vytautas Magnus University	Social science	Bachelor
S9	University of Luzern	Natural science	Master
S10	Vytautas Magnus University	Social science	Master
S11	Vytautas Magnus University	Social science	Master
S12	Pädagogische Hochschule Luzern	Social science	Bachelor
S13	Vytautas Magnus University	Social science	Master
S14	Taras Shevtchenko National University of Kyiv	Humanities	PhD
S15	Vytautas Magnus University	Natural science	Bachelor

Ethics

Participation in the research was completely voluntary; participants could refuse their participation at any time. All the participants were informed about research purposes and procedures and agreed with them by signing the informed consent form before the interviews.

Participants' names were coded; no personal information was revealed. To ensure data privacy, all the transcribed interviews, audio recordings and other research-related documents were stored on the personal computers of researchers in password-protected folders.

Data Analysis

A hybrid thematic analysis was employed, following the framework elaborated by Swain (2018). It combines both deductive and inductive approaches, allowing codes to be generated from pre-defined theoretical concepts as well as from patterns emerging directly from the data. For accessing students' awareness, a metacognitive framework was applied, as it allows the researcher to explore students' awareness of the application of GenAI systematically. Hybrid thematic analysis helped to receive significant insights not only to feed into the metacognitive framework elements and to provide answers to research questions but also to reveal that the data supports the existing patterns of the reasons and the ways students apply GenAI in their learning. Researcher reflection and hybrid thematic analysis were essential to reinitiate data analysis on the basis of the codes that have already been identified to further fine-tune them and revise in the new light, not referring only to the existing elements of the metacognitive framework, but to come back to the research questions, read through all the data and to search for new meaningful coding of the data.

The analysis followed seven interconnected steps: (1) interviews transcripts were organized in the two-column table to record emerging codes; (2) deductive codes were developed based on elements of the metacognitive framework (Table 3); (3) the transcripts were read to become familiar with the data; (4) after the data was coded within deductive codes, the inductive coding began through second in-depth reading and analysis of the interviews (Table 4), the inductive coding of the data was found helpful for the answering the research questions; (5) the coded data were summarized to provide an overview across participants, (6) related codes were grouped, (7) once the themes were analyzed, sub-themes were identified and interpreted.

Table 3

Deductive Coding Framework

Theme	Sub-theme	Codes
Metacognitive knowledge	Knowledge about oneself as a learner	Personal strengths, weaknesses, learning preferences, learning pace, self-efficacy.
	Procedural knowledge	Strategic use, task-specific application, building prompts, GenAI operations.
	Conditional knowledge	Contextual application, selective usage, GenAI limitations, GenAI strengths .
Metacognitive regulation	Planning	Goals setting, prioritization of tasks, decision-making process, step-by-step planning.
	Monitoring	Prompt revision, effectiveness within specific tasks, relevance check, conditional trust.
	Controlling	Prompt refinement, adjusting to GenAI limitations, considering ethics, balanced usage, output editing.
	Evaluation	Assessment of GenAI effectiveness, reflection on outcomes, impact on grades.

Table 4
Inductive Coding Framework

Theme	Sub-theme	Codes
Patterns of GenAI application within the learning task	Students are reliant on GenAI for routine tasks	GenAI for simple tasks, GenAI for translation, daily tasks, low-value tasks, efficiency and time saving, time constraints.
	Students tend to remain aware of their personal and GenAI input for creative tasks	Self-expression, loss of authenticity, balance between GenAI and personal output, GenAI limitations within creative tasks.
	Students critically assess GenAI outputs within analytical tasks	Complex tasks, analytical tasks, lack of trust in GenAI.
Drivers of GenAI adoption in learning	Psychological and physical states	Tiredness, frustration about the task, physical state.
	Lack of interest in subject	Interest in the task, GenAI for not interesting tasks.
	Knowledge gaps	GenAI usage for missing information, GenAI for clarification, learning assistance.
	Teachers` attitude	Processors' influence, restrictions on GenAI usage, fear of being caught.
Awareness of GenAI misuse	Bypassing useful cognition	Prioritizing the fast solution, acknowledging misuse, awareness of consequences, skipping the learning.
	Awareness of overreliance	Resistance to overreliance, reliance on AI to save time, acknowledgement of GenAI role, acknowledging the risks, awareness of consequences.

Results

During the thematic analysis of the data collected, five themes were identified. Two themes, namely metacognitive knowledge and metacognitive regulation, were identified in a deductive way within the use of metacognitive framework elements to explore students' metacognitive skills in a structured and systematic way. The other three themes, namely, patterns of GenAI application in learning tasks, drivers of AI adoption in learning and awareness of AI misuse, were identified inductively, since these themes emerged originally from the data and reflect direct observations and insights gained from students' interviews.

Theme 1. Patterns of GenAI application in learning tasks

Students are Reliant on AI for Routine Tasks

This pattern was represented in the majority of the interviews. The results show that students quite often use GenAI for routine tasks, such as text translation, information summarization, literature list generating, or finding appropriate references for the paper. The majority of students perceive these tasks as not critical or not very important, so they are rather inclined to delegate them to GenAI. Participants state that accomplishment of such tasks does not significantly impact the learning outcomes or student performance:

> *When the task is not about sharing my thoughts or something that I should produce, like creating a list of literature or finding references, I rely on AI a lot because it's not critical; it is something I can delegate, and I did not want to spend my time on this.* (S14)

When the task is perceived as not important or not interesting, students demonstrate resistance to spending time on it and rely on GenAI to raise the efficiency of the learning process. Routine tasks are always associated with automated machine work, which is characterized as requiring a lower level of cognitive involvement. Students are also less critical towards the results achieved through such tasks, and they trust these tasks to GenAI most often:

> *I'd say that I use GenAI for almost every task that I have. Since it helps me to save a lot of time. Most of the time I use AI just for structuring information; for example, if I have a presentation, I just upload a certain document with the information, and I ask AI to structure it. I use it as a summarizer basically; that's it.* (S9)

StudentsTend to Remain Aware of Their Personal and GenAI Input for Creative Tasks

Creative tasks are another type of task when GenAI is widely used. This pattern was represented in the interviews of 8 out of 15 students. GenAI is used for idea generation and brainstorming, generation of images and videos, as well as PowerPoint presentations (slides and visuals). However, if compared to the other types of learning tasks, students tend to be more selective in the way they use it for creative tasks. Some students express doubts about GenAI's abilities to assist them with creative tasks. Some students think that creativity aligns more with human nature:

> *I understand that I need to check a lot of things, so yeah, that's why I never use AI to write a whole essay for me, because then I will just waste a lot of time editing this, to be sure it reflects what I want and need, so it's just won't be easier in the end. It's easier to just brainstorm and then write it by myself.* (S8)

The artificial nature of GenAI is commonly perceived as its weak characteristic when it comes to completing complex creative tasks which need a "human touch". Some students claim that they are selective towards applying GenAI for complex creative tasks because they are concerned with the authenticity of the final work:

If that is a reflection or essay I need to write, something related to my context and experience, I will do this myself and will not involve ChatGPT. If that is related to creating visuals or a presentation canvas, I will never use AI since I enjoy the process. And I like it when creative tasks have my "personal touch". But if I need to brainstorm ideas or get some inspiring hints for the task, then I will use it. (S3)

Creative tasks usually require personal reflection and serve as a way of self-expression, so students tend to avoid using GenAI for such tasks which require their personal input, representing their personal experience. This argument proves that some students value creative tasks more than other types of tasks.

It is interesting that creativity itself is considered a valuable personal characteristic. Students who consider themselves creative treat creativity as a kind of self-expression; thus, they prefer not to delegate tasks that help them to express themselves and represent their creative side to GenAI:

I use AI for brainstorming some ideas; however, if we're talking about something like helping with essays, poetry, or content creation in general, then no, I always write it myself because, for me, creativity is about self-expression. I believe you do not need AI to express yourself. (S8)

Students critically assess GenAI outputs within analytical tasks

This pattern was represented in the interviews of 11 out of 15 students. GenAI is widely used by students for different tasks; however, the most popular ones are tasks that require text or data analysis. Analytic tasks include such steps as asking GenAI to analyze text, to outline the structure for a presentation or essay based on a given text, to conduct a comparative analysis of data or to find specific information in large amounts of text. Participants perceive these tasks as time-consuming, but they also recognize a high level of their importance for learning. Students claim that such tasks require cognitive involvement to assess the output generated by GenAI tools critically. Students also acknowledge limitations of GenAI for implementation of such tasks:

So sometimes I have difficulties with structuring a presentation. So, I ask AI to make a plan for me, and then I choose from it. AI works well with outlining the structure; however, if you are not precise with the prompt, it can miss some important aspects, so you need to check if it matches the main text and guidelines. (S5)

Theme 2. Drivers of GenAI application

This theme was inductively discovered through the data analysis and reveals drivers of GenAI application among students. It reveals the four internal and external reasons which make students more likely to engage in the application of GenAI for learning.

Psychological and physical states

The data analysis shows that 7 out of 15 students tend to be more engaged in GenAI application for learning tasks due to their psychological or physical state,

which includes cognitive fatigue, poor physical health state, and frustration with the tasks or learning activities:

> *If my physical health is not good, or if this task is not a priority but I need to do it, I will use AI.* (S5)

Tiredness also remains one of the important factors that make students more likely to apply GenAI, as they understand that it will make the process easier for them:

> *Sometimes I am just so tired that my brain doesn't want to find new solutions or just think of new ideas. I know it is not effective to force myself to think at these moments, so I use AI.* (S14)

Psychological or physical states are related to internal factors, as they rather represent students' feelings and perceptions of their own states than external influence. The worse their states are, the more they use GenAI:

> *When I needed to make a presentation, and I saw there was no clear guidance from the teacher or no description on Moodle, I felt frustrated, like I was stuck. So yeah, when I am stuck and lost, and I don't know what to do next or what to add, I would ask AI.* (S5)

Lack of interest in a subject

The level of students' interest in the topic or subject strongly affects the extent to which they apply GenAI for the task. This driver was represented in 8 out of 15 students' interviews. It demonstrates that the less interest students have in a specific topic, the more likely they will apply GenAI for task completion:

> *If I didn't listen to lectures, for example, and I don't like the subject, especially if I don't like the subject, I don't put effort into it. And if I have some different priorities, some different tasks that are more interesting, I would do this less interesting task with AI.* (S5)

If students are not interested in the topic, they usually are unwilling to spend time and effort on familiarization with the topic and performing the task on their own:

> *Some classes are not that interesting and not that important for my current studies or for my future research, and when I just don't want to waste time on it.* (S14)

And on the contrary, if they really like the topic, they are more likely to use their own cognitive abilities and would avoid using GenAI:

> *If the task is something I'm genuinely interested in, I might not use AI out of principle.* (S9)

Knowledge gaps

One of the most common uses of GenAI in education is clarifying information or seeking an explanation of subject-specific concepts, which students might struggle to understand. The analysis shows that 12 out of 15 students engage in applying GenAI

when they have knowledge gaps which do not allow them to complete the task or when they find the task too complicated. In such cases, they seek assistance and ask GenAI tools to make things more understandable:

> *Usually, I try to do tasks by myself, but if there are, as I mentioned, knowledge gaps, I ask for ideas from the AI to generate some things.* (S7)

Sometimes these knowledge gaps might not be explicit, but implicit; thus, students ask GenAI to advise them if they miss some knowledge or data within the task.

> *For one subject, were doing a project together with a group, so I needed to do some mapping, we already made one in the classroom, so I asked AI this question again, and then it showed a certain map from this project, and I found that maybe there's something more that I can add, some more details because our map was a bit missing of some parts.* (S6)

Teachers` Attitude

One of the interesting factors which affect the level of students' engagement with GenAI is the teachers' attitude toward GenAI within the course. 8 out of 15 students stated that when the teacher has a positive attitude towards using GenAI, students most likely will use GenAI and will do it transparently. Also, students highlighted that they appreciate professors' support and trust expressed for the use of GenAI. When the trust and support are expressed by the professors, they would not only use it most often, but would also do it with more responsibility to justify the trust received:

> *I think more or less it sometimes comes from the professors themselves, if they are actually kind of supporting the use of a device, of course, with you know mitigating or kind of giving the chance to the student to be received as a responsible one for using AI.* (S11)

However, if the teacher encourages students not to use GenAI, but rather to engage within the task themselves, the students would either reduce the use of GenAI within the task or would simply hide the fact of its application:

> *We had one course, and the teacher said it is okay if you have mistakes in your assignment. You don't need to edit your work, and you don't need to use AI. So, it helped me to, I thought, maybe I shouldn't use that. Because some professors tell us, don't use it. It's okay to have some grammatical mistakes; it's fine. You don't have to be perfect.* (S5)

It is important to highlight that discouragement to use GenAI may also lead to unethical behavior by students who would hide the fact about the use of GenAI. The reason for such behavior would be students' fear of facing the consequences, which might lead to deterioration of their grade and overall performance:

> *And if I know that the professor is, like, not that strict and is probably not going to check if it's generated by AI, I will most probably use most of the parts.* (S6)

Theme 3. Metacognitive knowledge

This theme explores students' metacognitive knowledge. Metacognitive knowledge is one of the key components of metacognition. It refers to learner awareness of themselves as learners, awareness about the use of GenAI and about how students control the processes of GenAI application. The data were analysed deductively to explore students' awareness of themselves as learners, awareness of how to use GenAI (procedural knowledge) and awareness of the contextual application of GenAI within learning (conditional knowledge).

Awareness of Oneself as a Learner

13 out of 15 students demonstrated understanding of their learning process, the pace they have and their strengths and weaknesses, which can be diminished with the help of GenAI:

> *I know AI helps me with structuring tasks and generating ideas when I'm stuck, but I avoid it for creative writing because I enjoy doing that part myself and think I'm good at it.* (S8)

Understanding their weaknesses allows them to approach the task more systematically, so they know during which part of the process they need to use GenAI to get the help they need:

> *I know that I often struggle with brainstorming or organizing my thoughts, so I use AI to get started.* (S3)

The understanding of their strengths and weaknesses demonstrates that students reflect on how they learn better, what knowledge they might lack or how GenAI can help them on their learning path within their specific way of learning:

> *Personally, I think my writing skills are not very good. They've always been at a low level because I've never liked writing. When AI can help, I use it.* (S2)

Awareness of how to use GenAI

In terms of GenAI application within the learning process, procedural knowledge requires the understanding of the task and student awareness about how GenAI can be used to address specific learning problems that students face during implementation of the task. 10 out if 15 students demonstrate awareness about the use of GenAI addressing specific learning problems with the task:

> *If I need to write an essay or something like that, then I would probably use AI just to have that little plan.* (S6)

Participants demonstrate understanding of GenAI's weaknesses as a tool, explaining its limitations in providing information to answer specific questions or to help with a specific task:

If the task involves specific or contextual information like governmental issues in my country, AI doesn't always have accurate or sufficient data. In those cases, I handle that part myself because it's more effective and relevant. (S10)

Awareness of GenAI Contextual Application

12 out of 15 students demonstrated strong awareness about the contextuality of GenAI applications and their own selectivity in using GenAI. Student awareness about GenAI contextuality was expressed by the students in several ways.

First, they assess the complexity and type of the task:

If it's a difficult task, if I don't understand it instantly, then I will use GenAI. But if it seems like an easy task, then I will do it myself. (S6)

Second, they check university and course guidelines, task-specific requirements and consider teachers' attitudes towards the application of GenAI for tasks and assignments since they are cautious that it might directly influence their grade or performance:

If I know that the lecturer or the professor is quite strict with GenAI and is most definitely going to check if I used it, I will try to use GenAI less and make its answers as human as possible. (S4)

Theme 4. Metacognitive regulation

Metacognitive regulation is the second important component of the theoretical framework of metacognition and refers to students' self-regulatory skills within their learning, such as planning, monitoring, controlling, and evaluation.

Planning of GenAI application

6 out of 15 students demonstrated strong awareness of GenAI application through the planning phase. 5 students said they either do it intuitively or based on their previous experience, while 4 students stated that they didn't consciously plan GenAI use at all. The planning is shown by the task analysis (type and complexity) and understanding what they need to use GenAI for and how it can help them to complete their tasks:

I mainly use AI if I have a knowledge gap. If I have a gap, I think of what information I miss and try to understand how AI can help me to find the answer and then ask it. (S7)

Some students actively use GenAI to get help to plan the performance of the task itself, to get a step-by-step guide and explanation for better understanding of the process. They do the task themselves but learn with GenAI how to approach it in the best way:

If I don't have a clear idea of a task, I ask ChatGPT to guide me, and it gives me a set of steps or guidelines. Once I have those guidelines, I try to follow them myself. If it becomes

too difficult, I go back and ask, "How can I make this happen?" I use it to break down the steps and get specific descriptions about how to proceed. (S10)

Some students carefully consider if they need GenAI for the tasks at all, assessing their knowledge, resources and abilities to achieve the goal without it:

First, I think of the task I have and the type of task, and then I analyze by myself if it would be good for me or not good for me to use AI. (S4)

They assess the task and its complexity first, and even if they decide not to use GenAI to achieve the task outcome, they still tend to use GenAI to receive some ideas and to double-check if their thoughts about task implementation are good:

Firstly, I think of whether I should use AI to brainstorm ideas, like whether there is a need for AI. That's maybe, again, regardless of the task, I would use, for example, AI to just brainstorm first, but normally, as I've already mentioned, it depends on the task itself. (S11)

Monitoring of GenAI Application

8 out of 15 students explicitly stated their monitoring skills. The monitoring process is explained through students' reflection on how they apply GenAI for their learning. Students reflect on whether and how the application of GenAI contributed to their learning goals, and the alignment of learning outputs with the guidelines and expected results. Students also reflect on how much aware they are of the use of GenAI:

Sometimes, if I use AI throughout the task, it's crucial to reflect on what AI has provided and check whether it's relevant to what I need. (S11)

Students also monitor the contribution that GenAI makes to their work, how they change or paraphrase their own words or texts reflecting on GenAI contributions, and if the task outcomes feel like something that represents themselves or not:

I use a website called DeepL, so I think it's artificial intelligence as well because it changes your style. You can choose if you want to write politely or if it's academic, so I use it a lot, but lately I think I don't want to use it, because it just erases all of my words and completely paraphrases them. (S5)

Controlling Application of GenAI

Controlling application of GenAI is probably the most explicitly represented part of metacognitive regulations (presented among 12 out of 15 students). All the students are aware of the need for critical assessment of the outputs generated by GenAI:

When I generate an idea, I cannot take it as it is; I read or try to understand the idea and try to see if it actually aligns with the guidelines that you have for the assignment. (S10)

Students do not blindly trust GenAI and are aware of its limitations; they tend to control the outputs created by GenAI to meet the assignment criteria and guidelines:

When I receive information from AI, I need to reflect and critically think about it, because sometimes it will not provide the answers that I need, so I need to see if it's the information that I need and how I should adapt it to my learning needs. (S7)

By adjusting the answers provided by GenAI or by adjusting the prompt for GenAI, they demonstrate the understanding of the importance of assessing GenAI outputs and engage with them through critical thinking:

I like to run through and like to make adjustments. Sometimes there isn't that much to adjust; sometimes I have to rewrite lots of stuff. But like I still don't trust it, and I' 'm not delegating the work made completely by it. (S14)

Evaluation of the Process of GenAI Application

5 students expressed a strong need to go through an evaluation of the process of GenAI application. They claimed that they evaluate all the aspects that GenAI has on their learning and its contribution to the achievement of the learning outcomes. 8 students demonstrated implicit awareness of the evaluation of the GenAI application and mentioned that they have some evaluation strategies; however, their evaluation is sometimes based on instinctive judgments rather than on critical understanding. 2 students claimed that they do not usually think of GenAI application process at all:

Sometimes it is just about feeling. I just got the feeling if it's ok or not since I've got some background, and when I see that the output is bad then I know it from my previous experience.

Usually, the assignments have guidelines and questions, and you know more or less what the theme is. After the task is done, I read through the output again and make sure it's not completely different from what I've been learning in lectures. I also always check if the text or assignment generated by AI matches the provided guidelines and what was asked in the task. (S6)

Even though students tend to evaluate the overall results of the application of GenAI, they tend to concentrate on its time-saving features rather than reflect on its effectiveness for the task implementation and its contribution to the task performance:

I'm just analyzing how much time I have wasted on asking ChatGPT about searching for the theories and how much time I would have wasted if I needed to read the article myself. (S8)

Theme 5. Awareness of AI misuse

Bypassing Useful Cognition

12 out of 15 students demonstrated awareness about GenAI misuse; 8 students demonstrated a strong understanding and awareness of GenAI misuse during their learning. Even though they understand that GenAI use disrupts their learning process and helps them to bypass useful cognition, they still tend to use it in some cases:

Sometimes I can just copy-paste. For once, I copy-pasted the answer for my biology tests because I wasn't into the subject; I wasn't into the topic. Unfortunately, I didn't have the time and desire to learn it. (S4)

Awareness of skipping the learning process is also closely associated with students' ethical considerations, as they are aware that it is not only bad for their learning, but it is not ethical either, or sometimes academically dishonest. This misalignment between their thoughts and actions is demonstrated in the following citation:

Maybe it was not ethical from my side when I used its assignment as my own and claimed that I did it. Well, it's definitely not ethical in any way, especially when it's like a creative task, and you don't need to cite anything. (S6)

Most of the answers demonstrate that GenAI misuse is caused by time constraints, academic workload or absence of interest in the topic or the subject:

I used AI to create a presentation from scratch. I just did not want to waste time on it, since it was not the main subject of my studies. I just did not find it important, so that is why I asked AI to do it for me. (S14)

Some of the students deeply reflected on the awareness of the misuse of GenAI in education, explaining it as a result of the rigidity of the educational system:

Basically, the degree should go to Gen AI, not me. But I mean, it just kind of shows the future in a way that maybe something in education and the higher education system needs to change because the skills that are needed are also changing. The tasks we get often do not correspond with the skills we need to develop. So, we use AI to skip it. Of course, it's not for good, and it's definitely not for the best, but it happens because the system is the same and the tools and the reality is changing. (S6)

Awareness of Over-Reliance

5 students claimed that they rely too much on GenAI, 5 stated that they rely on it sometimes, but can learn without the tool, and 5 students refused the fact of overreliance in their learning. Students are mostly conscious of how overreliance on GenAI deteriorates their own abilities to think and to solve problems independently. However, at the same time, they praise its time-saving abilities as a positive argument for balanced use:

With GenAI, it's a different kind of productivity. It saves me time by providing guidelines and assistance, which allows me to focus on other aspects of the task, but it also makes my abilities less sharp if I rely on it too much. (S10)

Besides that, students demonstrated awareness of GenAI duality, when on the one side, it can be a helpful instrument enhancing learning, but on the other side, diminishing their personal abilities in cases of overuse:

For me, it's just a tool that helped me. I used to rely on it before, but now I don't like to rely on it too much because if you're using it a lot, you start to get addicted and you don't think with your own brain. (S5)

Many students are also cautious that GenAI use affects their ability to think, to generate ideas and may have a long-term effect on their abilities to think and perform tasks independently:

In terms of idea generation, sometimes I find that I do not even try to think for myself before consulting with chat. Coz I know it will give me a range of ideas to choose from. But when it really happens that I need something specific, I feel so lost, coz my brain stopped working on this issue from scratch for a while. Maybe I relied on it too much recently. (S3)

But even though students are aware of their overreliance on GenAI, in many cases they fail to control the use of GenAI.

I rely on it heavily, probably to a very great extent. It's become a regular part of how I approach learning. (S9)

Some of the participants stated that if they could not use GenAI, they would get very frustrated, as it had already become a part of their daily study routine:

If GenAI were taken away from me, it would be a kind of cultural shock just to think on your own again. (S7)

Discussion

The research identified patterns of GenAI applications within different types of tasks, as well as the main drivers which motivate students to use GenAI. This study also explored students' awareness of GenAI applications in learning.

The first pattern identified in this research describes the way how students use GenAI within their routine tasks. Students tend to use GenAI for tasks which they perceive as *not important*, *repetitive or those which require summarization of the text or its translation*. These findings are similar to the arguments by Von Garrel and Mayer (2023), whose research concluded that students apply GenAI for translation and text summarization.

The second pattern explains how students apply GenAI for creative tasks and discloses students' being selective about when to apply GenAI and when not. The research data showed that students consider content creation tasks using media, PowerPoint presentations, but also brainstorming tasks as "creative". Similar findings were identified by Chan and Hu (2023), who argued that students have a specific approach towards GenAI application for this type of task. Researchers claimed students avoid the application of GenAI within tasks that involve their reflections or require deep emotional

engagement, because GenAI cannot generate knowledge output which maintains the "human touch", the willingness to keep the authenticity of their work and where students have a place of self-expression. It also reflects students' awareness of GenAI limitations and the importance of keeping their work authentic.

The third pattern shows the attitudes students have when applying GenAI for analytical tasks. The approach to using or not using GenAI for this type of task by students aligns with what Von Garrel and Mayer (2023) presented in their research and demonstrates a deep cognitive involvement in controlling the outcomes of such tasks. This attitude is opposite to the attitudes that students have towards the application of GenAI for routine tasks. The main difference lies in students' perception, as they treat this type of task as highly important; thus, they care about the results of these tasks more and cannot completely rely on GenAI-suggested outcomes. This pattern also demonstrates a high level of students' awareness and wishes to control their learning. These results align very much with the awareness level in Flavell's metacognitive framework (Flavell, 1979).

The drivers that engage students in GenAI applications include both internal and external factors. The results of this research support Chan and Hu's (2023) findings on increased usage of GenAI to cope with academic workload and deadlines. Among new drivers identified in this research, psychological and physical states of the art are to be mentioned, including tiredness, sickness (bad health condition), cognitive overload and the feeling of frustration. These psychological and physical state conditions make students use GenAI more likely. The lack of interest in specific tasks or subjects, along with the low importance of the tasks, as perceived by students, is another driver to use GenAI. Students are inclined to use GenAI when they lack understanding of the subject and want to improve their knowledge and skills. This driver aligns with Chan and Hu's (2023) findings and explains students' increased engagement in GenAI when knowledge gaps occur. In these cases, GenAI is used to clarify subject-related concepts, find missing information, etc.

The last driver identified through the interviews is the teacher's attitude. When teachers integrate GenAI in curricular and legitimize its ethical usage (encourage students to cite GenAI and not to be afraid to apply it openly within some tasks), students tend to use it and usually do this ethically. The trust received from the teacher encourages students to apply GenAI in more responsible and purposeful ways.

Conclusions

This research proves that the application of metacognitive strategies to measure student metacognitive awareness about the use of GenAI in their studies is crucial. On the one hand, students demonstrate high-level awareness about the application of

GenAI, but on the other hand, there is little evidence that they are ready to plan and manage their cognition, including knowledge about the strategies when and how to apply GenAI for learning. Students' awareness of GenAI application in the learning process was evident in terms of metacognitive knowledge and regulation; however, students lack sufficient planning and evaluation skills. Students are also well aware of the cases of GenAI misuse and overreliance, and possible consequences it could have for them; however, even though they are aware of it, in some cases they fail to control its misuse.

Research has proven that students demonstrate task-specific manner in using GenAI: for routine tasks, they tend to be more reliant and less critical; for creative tasks, they use it selectively and retain their personal input with GenAI's to keep authenticity; for analytical tasks, they tend to be more critical and less reliant, thus demonstrating awareness of the importance of critical assessment of AI outputs.

The study also identified four drivers of GenAI applications among students: physical and psychological states, lack of creativity, knowledge gaps and teachers' attitudes. These drivers reflect some systematic challenges, such as a need to update curricular and pedagogical approaches that would embrace GenAI and help students use it more responsibly.

Finally, the research revealed very rich information on students' awareness of GenAI misuse. Students admit and understand that in some cases they use GenAI not to support their learning but to "get the work done" and mostly explain it by time constraints, academic overload and lack of interest in the subject or task. Although all the students are confident that they can reach their learning goals without GenAI, some students continue to rely on it a lot. Most students express their awareness of skills deterioration, and only a few emphasize the positive impact of GenAI in terms of skills development, which demonstrates the high level of awareness of purposeful application of GenAI in higher education.

Limitations

This study has several limitations. This study had a relatively small number of participants within different disciplines, which could not provide a full perspective from diverse experiences and cannot be generalized to all students. As the data collection instrument consisted of open-ended questions, it mostly relied on students' self-reported answers, which, due to the sensitivity of the topic, may lack objectivity and honesty.

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Generatyviojo dirbtinio intelekto naudojimo aukštajame moksle sąmoningumo tyrinėjimas taikant metakognityvines strategijas

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Santrauka

Tyrimo rezultatai rodo, kad, priklausomai nuo užduoties pobūdžio ir tam tikrų veiksnių, studentai taiko generatyvinį DI. Tyrimu nustatyti taikymo modeliai (angl. *patterns*) atskleidžia, kokio tipo užduotims jie naudoja generatyvinį DI. Atlikdami kasdienes užduotis studentai linkę būti mažiau kritiški generuojamam turiniui, bet kūrybinėms užduotims naudoja DI atsargiau, sąmoningiau vertina generatyvinio DI pateiktą rezultatą ir savo asmeninį indėlį į

užduoties atlikimą, taip pat siekia labiau prisidėti prie užduoties atlikimo, kad ji būtų autentiška. Analitines užduotis studentai vertina kaip svarbias, kritiškiau ir mažiau pasitiki generatyvinio DI indėliu. Taip jie demonstruoja sąmoningumą ir kritiškai vertina generatyvinio DI prisidėjimą prie užduoties rezultatų. Tyrime išryškinti tokie generatyvinio DI taikymo veiksniai (angl. *drivers*) tarp studentų kaip fizinė ir psichologinė būsena, kūrybiškumo trūkumas, žinių spragos ir dėstytojų požiūris. Studentų sąmoningumas taikant generatyvinį DI akivaizdus vertinant jį žinių ir metakognityvinių strategijų perspektyvoje, tačiau studentams trūksta planavimo ir vertinimo įgūdžių. Tai paaiškina studentų selektyvų ir kritišką, bet kartais staigų ir neapgalvotą generatyvinio DI naudojimą aukštajame moksle.

Esminiai žodžiai: *GenAI (generatyvinis dirbtinis intelektas), aukštasis mokslas, metakognicija, metakognityvinis sąmoningumas.*

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