CZU: 159.955:004.8 **https://doi.org/10.59295/sum5(195)2026_48**

COGNITIVE EXTERNALIZATION AND PERCEIVED CHANGES IN THINKING IN THE CONTEXT OF ARTIFICIAL INTELLIGENCE USE

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This study examines cognitive externalization and perceived changes in thinking in the context of artificial intelligence (AI) use among university students. Drawing on theoretical perspectives of extended cognition and metacognition, a descriptive-analytic cross-sectional design was employed with a sample of 228 students from diverse academic fields. The findings indicate widespread integration of AI into academic activities, primarily for clarification, summarization, and information structuring. Duration of AI use was significantly associated with perceived changes in thinking and learning processes, suggesting possible adjustments in cognitive strategies and a tendency toward externalizing information processing. Although nearly half of the participants reported a positive impact on cognitive efficiency, a substantial proportion expressed concerns regarding reduced intellectual autonomy. Fear related to diminished independent thinking was associated with more negative evaluations of AI's impact. Overall, the results highlight an ambivalent dynamic between functional cognitive optimization and challenges related to metacognitive self-regulation.

Keywords: *cognitive externalization; artificial intelligence; cognitive autonomy; epistemic dependence; metacognitive knowledge; automation bias; extended cognition; perception of changes in thinking.*

EXTERNALIZAREA COGNITIVĂ ȘI SCHIMBĂRILE PERCEPUTE ÎN GÂNDIRE ÎN CONTEXTUL UTILIZĂRII INTELIGENȚEI ARTIFICIALE

Studiul examinează externalizarea cognitivă și schimbările percepute în gândire în contextul utilizării inteligenței artificiale în rândul studenților universitari. Pornind de la perspectivele teoretice ale cogniției extinse și metacogniției, cercetarea a utilizat un design transversal descriptiv-analitic, realizat pe un eșantion de 228 de studenți din diverse domenii academice. Rezultatele indică o integrare largă a aplicațiilor de inteligență artificială în activitățile academice, utilizate în principal pentru clarificarea conceptelor, rezumarea informațiilor și structurarea conținutului. Durata utilizării inteligenței artificiale s-a asociat semnificativ cu schimbările percepute în procesele de gândire și învățare, sugerând posibile ajustări ale strategiilor cognitive și o tendință de externalizare a procesării informației. Deși aproape jumătate dintre participanți au raportat un impact pozitiv asupra eficienței cognitive, o proporție considerabilă și-a exprimat îngrijorarea cu privire la reducerea autonomiei intelectuale. Teama legată de diminuarea capacității de gândire independentă a fost asociată cu evaluări mai negative ale impactului inteligenței artificiale. În ansamblu, rezultatele evidențiază o dinamică ambivalentă între optimizarea funcțională a proceselor cognitive și provocările legate de autoreglarea metacognitivă.

Cuvinte-cheie*: externalizare cognitivă; inteligență artificială; autonomie cognitivă; dependență epistemică; cunoaștere metacognitivă; biasul automatizării; cogniție extinsă; percepția schimbărilor în gândire.*

Introduction

Over the past two decades, the rapid development of artificial intelligence (AI) systems has substantially transformed the cognitive environment in which individuals learn, make decisions, and solve problems. While early digital tools were used primarily as informational support, contemporary conversational and generative systems intervene directly in processes of analysis, synthesis, and information organization. In this context, the human – AI relationship can no longer be understood solely in terms of technological efficiency; rather, it requires a psychological analysis of how cognitive externalization shapes the subjective experience of thinking.

The concept of cognitive externalization refers to individuals' tendency to transfer mental tasks to external supports in order to reduce cognitive effort and optimize performance. In contemporary digital environments, AI functions not merely as an information repository but as an epistemic agent capable of generating

explanations, structuring arguments, and offering alternative solutions. This functional expansion raises a question of central relevance for cognitive and educational psychology: how do users perceive the influence of AI on their own thinking processes?

The idea of cognitive externalization is closely related to the theory of the “extended mind” [1, 8], which argues that cognition does not take place exclusively within the brain. In everyday functioning, people often incorporate external resources into their thinking processes. Digital technologies, for example, may support memory, attention, or decision-making to such an extent that they become part of the broader cognitive system itself. At the same time, this integration is not entirely neutral. Its effects depend on how actively individuals preserve their own evaluative and reflective involvement while using external supports. In the context of intensive reliance on digital tools, cognitive delegation can gradually shift from a practical strategy to a habitual mode of functioning. This tendency has been described as epistemic dependence — a reduced capacity or willingness to critically examine information obtained from external sources. From our perspective, such dependence may weaken cognitive autonomy, particularly in situations where information is accepted without sufficient reflection or verification.

Research defines cognitive externalization as the use of the external environment to reduce the demands placed on working memory and executive control. Experimental studies indicate that individuals tend to prefer externalization when internal cognitive costs are high or when the external alternative is perceived as more efficient [6].

Artificial intelligence changes the way cognitive externalization operates in everyday academic activity. In this case, externalization no longer refers only to storing information or recording ideas in notes. AI systems can participate more actively in the thinking process itself by generating text, reorganizing information, suggesting interpretations, or assisting with problem solving. Because of this, the delegation of cognitive tasks becomes more complex than in traditional interactions with digital tools. It may also affect the way individuals monitor and regulate their own thinking strategies, especially in situations where AI-generated responses are accepted with limited reflection.

The increasing use of AI applications in universities and other educational settings makes this issue particularly relevant. Students interact with such technologies not only for information search, but also for writing, summarizing, idea development, and academic planning. Although existing research offers important theoretical perspectives on extended cognition and metacognition, fewer empirical studies have focused on how users themselves experience these changes.

Against this background, the present study explores cognitive externalization and perceived changes in thinking associated with AI use. The analysis focuses on students’ patterns of interaction with artificial intelligence, the risks they associate with intensive use, and their own interpretations of how these technologies may influence cognitive autonomy and information processing.

Method and Objectives.

The rapid expansion of artificial intelligence applications has significantly transformed contemporary academic practices. Students increasingly use AI for writing, information synthesis, problem solving, idea generation, and organizing their learning process. At the same time, the literature highlights an ambivalence: AI can enhance cognitive efficiency and provide rapid access to information, yet it raises concerns regarding intellectual autonomy, superficial information processing, and the risk of cognitive dependence.

Study Objectives:

1. To identify the frequency, duration, and patterns of AI application use among students;
2. To analyze forms of cognitive externalization in academic and non-academic contexts;
3. To investigate perceptions of AI’s impact on thinking and cognitive autonomy;
4. To explore the relationship between AI exposure (frequency and duration) and perceived changes in thinking style;
5. To examine the role of affective evaluation (fear of reduced independent thinking) in interpreting AI’s impact on personal cognitive processes.

The study adopted a descriptive–analytical cross-sectional design, based on a questionnaire developed by the author to assess students' perceptions and use of AI. The sample included students at different levels of study (undergraduate and master's) from diverse academic fields.

The AI usage questionnaire covered the following dimensions:

- Demographic information: age, gender, level of study, academic field;
- Weekly frequency and duration of AI use;
- AI use in academic and non-academic contexts;
- Usage typology: writing, summarization, problem solving, idea generation, etc.;
- Fear of diminished capacity for independent thinking;
- Perceived advantages and risks (open-ended item);
- Self-assessment of changes in thinking and learning compared to the period prior to AI use.

The questionnaire items were formulated in both closed- and open-ended formats to capture not only the frequency of use but also the subjective experience of participants.

To assess the psychometric quality of the questionnaire, a preliminary validation was conducted using a pilot sample of 50 students. The purpose of this step was to evaluate the conceptual correctness of the items, their internal consistency, and the latent factorial structure of the scale, ensuring the reliability and validity of the constructs measured. Content validation was performed through consultation with three experts in psychometrics and educational psychology. The experts assessed the relevance, clarity, and adequacy of each item with respect to the targeted theoretical constructs. Inter-rater agreement coefficients indicated a high level of consensus, supporting the conceptual appropriateness of the items and confirming the content validity of the instrument.

Internal consistency was examined using Cronbach's α for the identified subscales: the scale capturing perceptions of AI's impact and the scale addressing concerns about its negative effects. Cronbach's α values ranging from .71 to .81 indicate satisfactory internal consistency for an exploratory instrument, suggesting cohesion among items and their capacity to measure coherent psychological constructs. Exploratory factor analysis applied to identify the latent structure of the items revealed a clear two-factor structure. The Kaiser–Meyer–Olkin (KMO) index reached an adequate value, and Bartlett's test confirmed the sphericity of the correlation matrix. The first factor reflects the dimension of perceived personal impact of AI use on thinking, learning, emotional regulation, and social relationships; the second factor reflects concerns about AI's negative effects. Factor loadings exceeding the .50 threshold confirm the validity of the identified structure.

The questionnaire was administered online, voluntarily and anonymously. Participants were informed about the study's objectives and assured of data confidentiality. Data collection occurred within a defined period, without any experimental intervention.

Data analysis was conducted in two complementary stages. The first stage involved a descriptive analysis to highlight general patterns of AI use among students, through the calculation of frequencies, percentages, and measures of central tendency. In the second stage, a correlational analysis was performed to explore the relationships between AI usage frequency and duration, on one hand, and the fear of diminished independent thinking as well as the perception of changes in thinking and learning, on the other. Correlation coefficients were interpreted in terms of strength and statistical significance to identify relevant trends regarding the psychological impact of AI use.

Results

We first present the results, beginning with a descriptive analysis of the sample characteristics**.** The study was conducted on a sample of 228 respondents, all enrolled in formal academic programs at higher education institutions in the Republic of Moldova. Participants' ages ranged from 18 to 60 years**.** The distribution is asymmetric, with a significant predominance of young adults (18–22 years), who represent 64.5% of the sample**.** The remaining age groups are represented as follows: 23–29 years (12.7%), 30–39 years (12.7%), 40–49 years (7.0%), and 50–60 years (3.1%).

The sample structure indicates a dominance of students engaged in an academic trajectory, a factor that should be considered when interpreting findings related to cognitive externalization and AI use.

Regarding gender distribution**,** the sample is predominantly female, with 80.8% women and 19.2% men**.** Concerning field of study, 67.5% of participants are from the humanities, while 32.5% represent STEM (science, technology, engineering, and mathematics) disciplines. This distribution reflects a predominance of humanities-oriented training within the sample, which may influence cognitive styles, information-processing strategies, and patterns of AI utilization in academic activities.

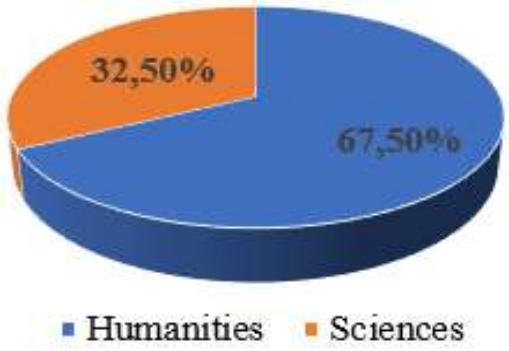

Fig. 1. Distribution of respondents by field of study / high school profile

Regarding the duration of frequent use of artificial intelligence applications, most respondents report having more than one year of experience (59.2%), of which 31.6% have been using AI for 1–2 years and 27.6% for over 2 years. A further 33.4% indicate relatively recent use (less than one year), while 7.5% report that they do not use such applications frequently.

This distribution suggests a significant integration of AI technologies into the participants' academic activities. It is also relevant to hypotheses concerning cognitive restructuring, as cognitive externalization is a gradual process, and automation bias strengthens with repeated exposure.

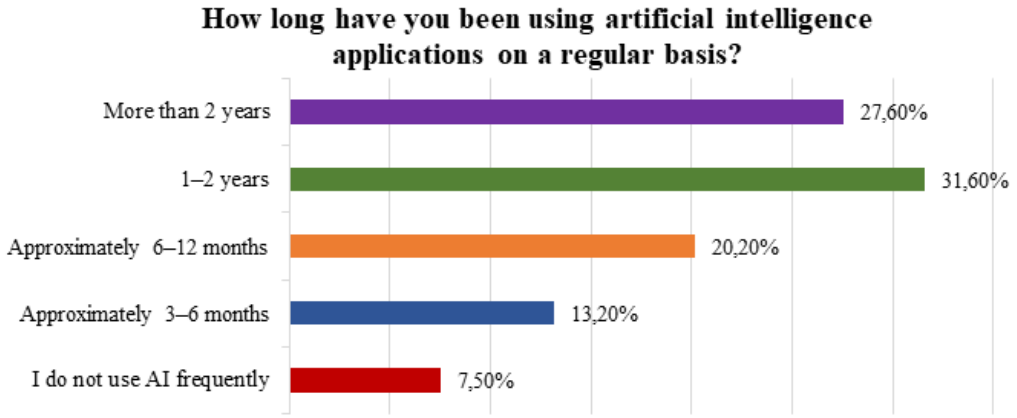

Fig. 2. Duration of frequent use of artificial intelligence applications among students

An even stronger variable than the duration of use is the current intensity of cognitive exposure to AI.

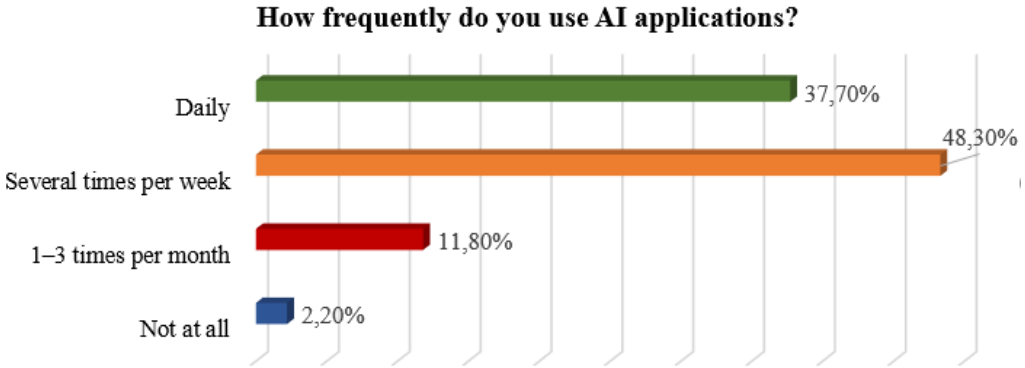

Fig. 3. Distribution of respondents by frequency of ai application use

Regarding the frequency of AI application use, 37.7% of respondents report daily use, while 48.2% use AI several times per week. Only 11.8% use it occasionally (1–3 times per month), and 2.3% report not using such applications at all. Overall, 85.9% of participants integrate AI into their weekly or daily activities, suggesting a high level of cognitive exposure to these technologies. This distribution supports the potential emergence of systematic cognitive externalization and perceived changes in metacognitive monitoring.

AI is integrated into the cognitive routines of the majority of respondents. Nearly 4 out of 10 use AI daily, indicating the possible formation of stable patterns of cognitive externalization.

Concerning the average weekly time spent using AI, most respondents (68.4%) report 1–3 hours, 18% use AI for 4–7 hours, and 7% exceed 7 hours per week. A further 6.6% indicate that they do not use AI. These data suggest a predominantly moderate use, with a minority of intensive users, indicating that AI is mainly used as a supportive tool rather than a constant substitute for cognitive activity.

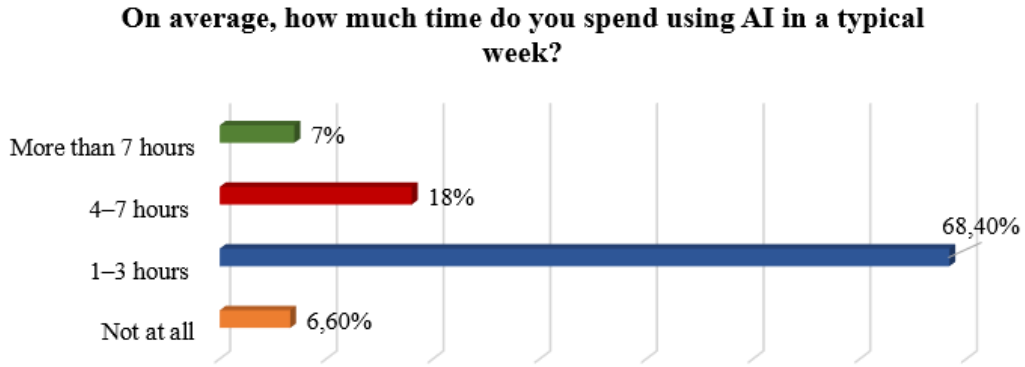

Fig. 4. Average weekly duration of artificial intelligence application use

A highly relevant question – because it reflects cognitive externalization specific to the academic context – concerns the use of AI in the preparation of assignments, projects, and academic studies (*see* Figure 5).

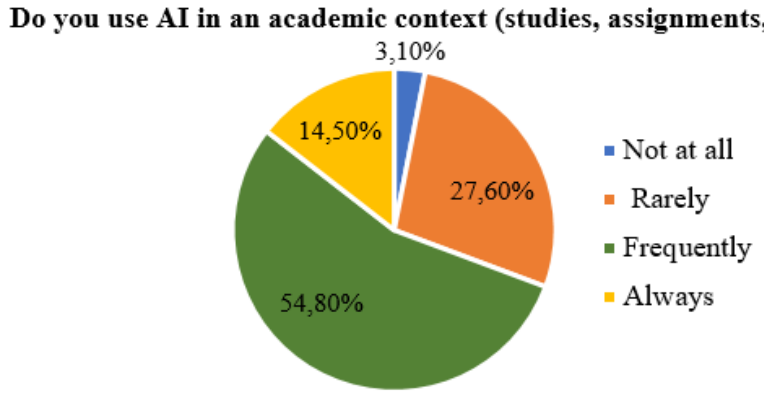

Fig. 5. Use of AI applications in academic contexts

Regarding AI use in academic contexts (studies, assignments, projects), 54.8% of respondents report frequent use, 14.5% use it consistently, 27.6% use it rarely, and 3.1% do not use it at all. These results indicate a strong integration of AI technologies into academic activities, suggesting that the majority of respondents partially or fully externalize certain cognitive processes to these tools.

The key question, reflecting concrete modes of cognitive externalization and enabling analysis of the types of tasks participants delegate to AI, is illustrated in Figure 6.

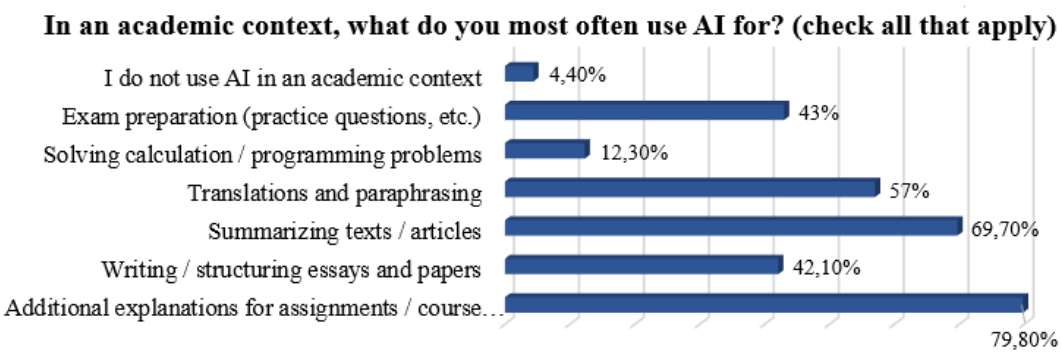

Fig. 6. Typology of AI use in academic activities

Participants were allowed to choose more than one response option; therefore, the total percentages exceed 100%. The results indicate that AI is used primarily as a support tool for understanding and processing academic information. The activities reported most often were requesting additional explanations for assignments or course-related concepts (79.8%) and generating summaries of texts or articles (69.7%). More than half of the respondents also used AI for translations or reformulations (57%). By comparison, tasks such as essay writing and exam preparation were mentioned by approximately 42–43% of participants, whereas the use of AI for technical or programming-related problems was relatively limited (12%). Only a small proportion of students (4.4%) reported that they do not use AI in their academic work at all.

Overall, these findings suggest different levels of cognitive externalization depending on the type of task involved. In many situations, AI appears to function mainly as a supportive cognitive aid. This is especially visible in activities such as clarifying information, summarizing content, or reformulating ideas, where students still remain actively involved in the learning process. At the same time, the use of AI for essay writing or exam preparation may reflect a more advanced form of cognitive delegation, since these activities involve not only information processing but also organization, interpretation, and production of responses.

Another interesting aspect concerns the uneven distribution of AI use across domains. Technical problem solving was reported less frequently, which may be related to differences between educational profiles, particularly between STEM and humanities students. Equally important is the very small number of non-users. The fact that only 4.4% of respondents avoid AI entirely suggests that these technologies are already integrated into everyday academic routines for most students.

Previous studies on decision automation describe the phenomenon of „automation bias”, namely the tendency to trust suggestions generated by automated systems even when those suggestions may be inaccurate [4, 5]. In the context of conversational AI, the issue extends beyond simple factual mistakes. Repeated reliance on automatically generated answers may gradually reduce the habit of critical verification and independent evaluation. From our perspective, this is particularly relevant in educational settings, where excessive dependence on external cognitive support could influence intellectual autonomy and reflective judgment over time.

The ways in which AI is integrated into students’ personal lives outside the academic environment are illustrated in the following figure.

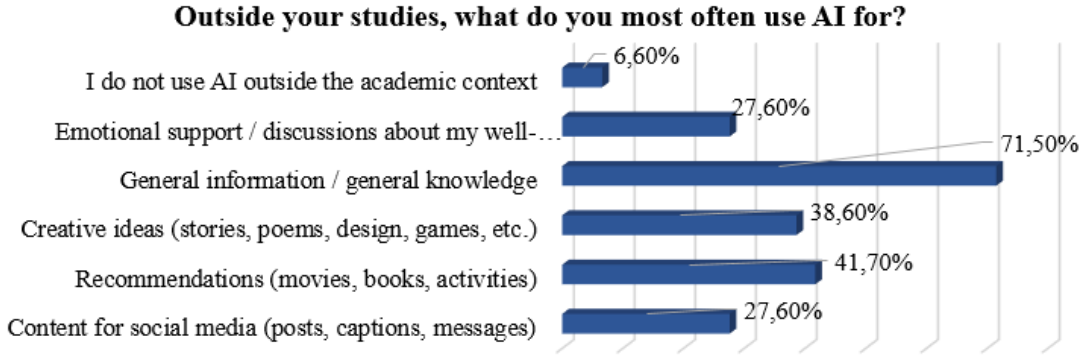

Fig. 7. Purposes of AI application use in non-academic contexts

Outside the academic context, participants primarily use AI for general information and general knowledge acquisition (71.5%). Other frequent uses include recommendations for movies, books, and activities (41.7%) and creative idea generation (38.6%). Use for social media content creation and emotional support is less frequent (27.6%), while 6.6% of participants do not use AI outside their studies.

From the data, we can observe different types of externalization:

- General/informational cognitive externalization: AI as a tool for rapid access to knowledge and as a guide or decision assistant.
- Creative/playful cognitive externalization: AI supporting imaginative and experimental processes.
- Socio-emotional externalization: AI as a semi-reliable interlocutor for personal reflection.
- Instrumental/practical use: AI as a tool for optimization and efficiency.
- Non-use: 6.6% do not use AI outside academics – a minority, indicating AI’s integration into daily life.

Thus, AI use outside academic activities is predominantly informational, suggesting that participants externalize processes of information search and filtering. Creative and playful activities indicate an extension of AI into personal metacognitive functions, reflecting a restructuring of how thinking and imagination are supported by AI. Emotional support represents a minor, yet interesting, use from the perspective of AI–human psychological interaction.

Drawing on the literature, frequent AI use is not limited to occasional cognitive externalization but may lead to a restructuring of the balance between internal cognitive processes and those externalized. This restructuring may take different forms:

1. Adaptive – AI is integrated strategically, without reducing internal monitoring;
2. Compensatory – AI supplements perception of personal limitations;
3. Dependent – internal metacognitive control is systematically reduced.

Therefore, the human–AI interaction should be analyzed not only as technological optimization but also as a process transforming the architecture of cognitive self-regulation [3, 9].

Another important question examines the subjective perception of the risk of cognitive dependence and fears related to the externalization of thinking (*see* Figure 8).

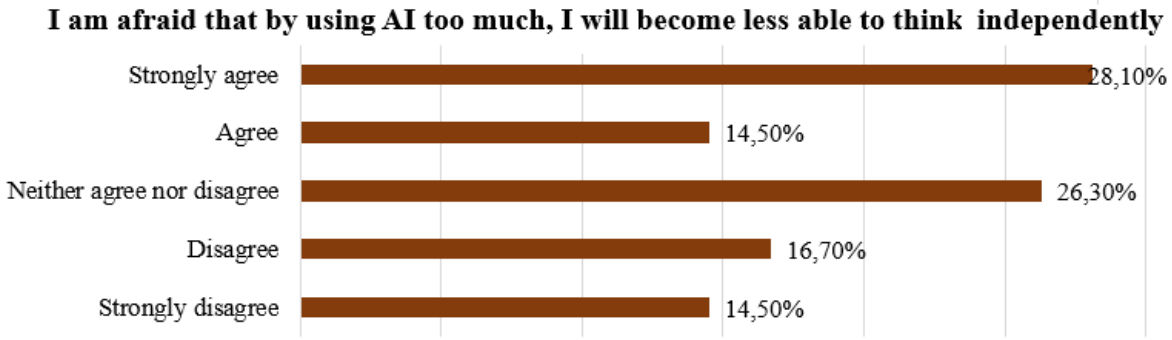

Fig. 8. Perceived risk of reduced cognitive autonomy associated with AI use

Regarding the perceived risk of losing the ability to think independently, 28.1% of respondents strongly agree and 14.5% agree that excessive AI use could reduce their capacity for autonomous thinking. In contrast, 14.5% strongly disagree and 16.7% disagree, while 26.3% remain neutral. Overall, nearly half of the participants (42.6%) perceive a potential risk of cognitive dependence, whereas roughly one-third do not share this concern. These results indicate that, while AI supports cognitive externalization, there is an awareness of its limitations and associated risks.

A qualitative observation highlights the high frequency of AI use in academic contexts (85.9% weekly or daily) and the fact that almost half (42.6%) perceive a risk of cognitive dependence. This suggests that more frequent AI use is associated with greater awareness of potential cognitive dependence, as respondents who integrate AI daily or weekly appear more likely to recognize its impact on autonomous thinking.

To test the hypothesis that AI usage frequency is significantly associated with the level of fear regarding diminished independent thinking, we applied the Chi-square test of independence (χ^2). The result, $\chi^2(12) = 18.88$, $p = 0.092$, indicates that the association between AI usage frequency and fear level did not reach statistical significance (χ^2 not significant, $p > .05$). Therefore, fear of reduced autonomy is not statistically determined by AI usage frequency, and frequent use does not automatically imply cognitive anxiety.

We also tested the hypothesis that duration of AI use significantly influences the perception of changes in thinking and learning. Results from the Chi-square test were statistically significant: $\chi^2 (12) = 21.68$, $p = 0.041$. This indicates that AI usage duration is significantly associated with how respondents perceive changes in their thinking and learning processes. From this, we can infer that prolonged AI use may lead to: restructuring of cognitive strategies, externalization of information processing, metacognitive changes, and adjustments in learning style. Duration appears to be a more relevant predictor than frequency of AI use.

The next question concerns the perception of changes in thinking under the influence of AI use. In our study, when asked about their perceived changes in thinking, respondents provided the following answers (*see* Figure 9).

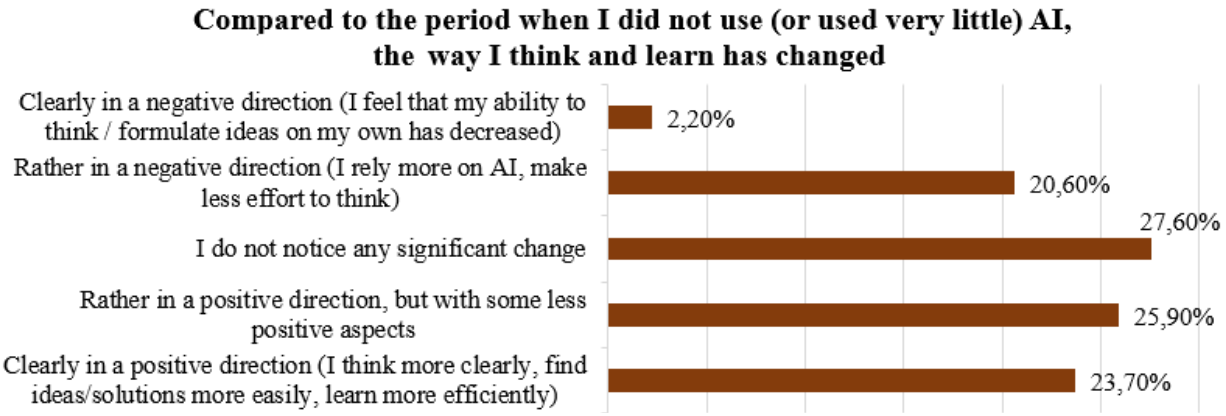

Fig. 9. Perceived changes in own thinking in relation to AI use

Regarding how AI has influenced thinking and learning, 23% of respondents consider the change clearly positive, and 25% view it as rather positive. 27.6% report no significant change, while 20.6% perceive a rather negative influence, and 3.8% see it as clearly negative. Overall, nearly half of the participants (48%) experience a positive impact on their cognitive and learning processes, whereas approximately a quarter (24.4%) perceive a negative effect. This suggests that AI can serve as a supportive tool but may also influence cognitive effort.

The distribution is bipolar, with a slight tendency toward positive effects. The “rather negative” segment is more pronounced than the “clearly negative” one, indicating that most participants perceive moderate cognitive dependence effects rather than severe deterioration.

Another hypothesis examined the relationship between fear of reduced independent thinking and the perception of negative changes in thinking. Binary logistic regression analysis indicated that fear levels are significantly associated with the perception of negative changes ($p < .001$). Higher fear correlates with a greater likelihood of interpreting AI’s impact negatively ($OR > 2$). Specifically, for each one-unit increase in fear, the odds of perceiving a negative change increase 2.38 times. Therefore, the hypothesis is statistically supported, suggesting that fear functions as a cognitive-evaluative factor influencing how participants interpret the impact of AI on their mental processes.

To integrate dimensions of AI exposure and perceived cognitive impact, we constructed a „cognitive externalization map”, combining frequency and duration of AI use, types of externalized tasks (academic and non-academic), and perception scores of risks and change in thinking. This map highlights: groups with high exposure and positive impact, groups with high exposure and negative impact, groups with low exposure and variable effects, providing a visual and integrated representation of how AI reshapes cognitive strategies and subjective experiences of thinking in both academic and personal contexts.

High Exposure, Positive Perception Individuals characterized by high AI exposure and a predominantly positive cognitive appraisal. *Examples:* 23% “clearly positive” + 25% “rather positive,” daily/weekly frequency.	Low Exposure, Positive Perception Use AI minimally, but perceive positive effects.
High Exposure, Negative Perception Frequent use, but perceiving a risk of cognitive dependence. *Examples:* 20.6% “rather negative” + 3.8% “clearly negative.”	Low Exposure, Negative Perception Non-users who believe AI may affect thinking (minority).

To identify the main tendencies in students’ perceptions of AI use in cognitive activities, a qualitative thematic analysis was carried out on the open-ended responses to the question: „In a few sentences, briefly describe what you consider to be the most important advantage and the most important risk of using AI.”

The categories were developed inductively by grouping similar semantic patterns that appeared repeatedly across participants' answers. After this stage, the categories were organized according to the frequency and consistency with which particular themes were mentioned.

The analysis shows a clear predominance of positive perceptions regarding AI use. Students described advantages in more concrete and detailed ways, whereas risks were usually mentioned briefly and in hypothetical terms. This suggests that AI is viewed primarily from a practical and utilitarian perspective, with emphasis on its immediate academic benefits. At the same time, some responses also reflected concerns related to dependence on technology, reduced critical thinking, and excessive reliance on AI, although these aspects were discussed less extensively.

The frequency analysis shows that ***the perceived advantages of AI*** can be organized into several main categories, depending on how often they are mentioned and how central they are in students' responses.

- The most prominent theme concerns the speed of access to information (around 35–40% of responses). Students frequently refer to time-saving, instant answers, and the possibility of obtaining information within seconds. In practice, this aspect seems to play a key role in how AI is valued in academic work, since efficiency in time management is repeatedly emphasized in their descriptions.

- A second important category refers to support in understanding and structuring information (25–30%). Here, AI is described as useful when dealing with complex concepts or when organizing academic content in a clearer form. Rather than simply providing answers, it is seen as a tool that helps make information more accessible and easier to follow.

- Another frequently mentioned aspect is the improvement of efficiency in routine or mechanical tasks (approximately 18–22%). This includes activities such as summarizing texts, correcting language errors, or selecting relevant information from larger materials. Although clearly useful, this dimension appears somewhat less central compared to speed and conceptual support.

- Finally, a smaller proportion of responses (10–15%) refers to support for independent learning and self-assessment. This metacognitive dimension is less visible overall, but it tends to appear more often in the answers of students who reflect more explicitly on their own learning strategies.

The risks associated with cognitive externalization can be grouped into several categories, depending on their frequency and perceived importance. The most prominent concern refers to dependence on AI and a gradual reduction in autonomous thinking (approximately 40–45%). This is the most frequently reported issue in students' responses. They mention, in various forms, the weakening of critical thinking skills, difficulties in producing independent answers, and the tendency to rely on AI outputs without sufficient verification.

A second category concerns the reduction of research engagement and in-depth analytical capacity (25–30%). In many responses, this is described as a continuation of cognitive dependence, particularly in situations where students bypass original sources or avoid detailed analysis of academic materials.

Less frequently, respondents refer to excessive simplification of tasks and the over-automation of cognitive processes (around 15%). In these cases, student's express concerns about reduced intellectual effort and a potential decline in creativity when AI is used extensively in academic work.

Finally, a smaller proportion of responses (5–10%) mention the possibility of errors or incomplete information provided by AI systems. Although this issue is epistemologically relevant, it appears to be less salient for students compared to longer-term concerns related to the development of independent thinking and learning habits.

The hierarchical structuring of themes suggests the existence of a pragmatic cognitive profile regarding AI use among students. In most cases, AI is valued mainly for its speed and practical efficiency, especially in tasks that require quick access to information or text processing. The metacognitive dimension – meaning reflection on one's own thinking processes – appears less prominent in students' responses and is usually mentioned only indirectly.

When discussing risks, students focus less on the accuracy of information and more on potential effects on cognitive autonomy and critical thinking. In other words, the concern is not so much that AI might be wrong, but that it might gradually reduce independent intellectual effort.

Overall, the data point to an ambivalent pattern. On the one hand, AI is clearly perceived as useful and efficiency-enhancing in academic work. On the other hand, there is a parallel awareness—though less strongly articulated—that frequent reliance on such tools may affect the development of independent thinking skills.

Conclusions

- The findings of this study show that artificial intelligence is already embedded in students' academic routines and is regularly used in a variety of learning-related activities. In most cases, students rely on AI in a supportive way, especially for clarifying concepts, summarizing materials, and organizing information. This pattern suggests that AI is mainly functioning as a tool for increasing efficiency in everyday academic work, rather than replacing core cognitive effort entirely.

- The results indicate that longer exposure to AI tools is more strongly associated with students' perceptions of cognitive change than the simple frequency of use. This pattern is consistent with the extended cognition theory, which suggests that external tools can become progressively integrated into cognitive processes over time, particularly when they are regularly employed in problem-solving and learning activities.

- Students tend to emphasize the practical benefits of AI, especially time efficiency and easier information management. At the same time, they also point to risks such as dependency on technology and a possible decline in critical thinking skills, although these concerns are expressed less consistently.

- Cognitive externalization through AI is not perceived as a direct epistemic threat. Rather, it is experienced as a gradual shift in how learning is organized and how thinking is supported. From an educational perspective, this highlights the importance of strengthening students' metacognitive awareness and encouraging critical, reflective use of AI tools, so that technology functions as a support for intellectual development rather than a substitute for it.

Study Limitations

The data were collected exclusively through self-report, which may introduce distortions related to social desirability, estimation errors, or discrepancies between subjective perceptions and objective cognitive changes. The sample structure – predominantly female and largely from a humanities background – limits the generalizability of the findings to other academic or professional populations. These limitations highlight the need for future research employing a longitudinal design and more diverse samples, which would allow for a clearer understanding of the nature and extent of perceived changes in thinking in the context of artificial intelligence use.

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Presented: 27.02.2026
Reviewed: 30.04.2026
Accepted for publication: 20.05.2026