Bridging Motivation and AI in Education: An Activity Theory Perspective

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ABSTRACT

After the pandemic, research on Artificial Intelligence (AI) in the field of education has seen a significant increase globally. However, a few studies conducted before the pandemic addressed the problem of supporting intrinsic motivation in students, crucial for the quality of learning and knowledge retention. This study explores how this topic is covered in recent research, by conducting a cross-disciplinary literature review and critical discourse analysis under the theoretical framework of Activity Theory (AT). It aims to identify the coverage extension of all types of relationships between nodes in the educational activity system, with special attention to Subject (students) and Object, as this central relationship embodies the motive-driven nature of human activity. The analysis incorporated 69 articles from Scopus published from 2020 until now. The results demonstrate the coverage about only some relationships like: Subject-Tools (students' interaction with AI technology), Tools-Object (AI technologies development), and Tools-Community (adapting AI within an educational community). The Subject-Object relationship remains unexplored. Practical implications include refocusing on intrinsic motivation, emphasising epistemological needs, meaning, and choice. This involves evaluating the benefits and risks of AI in specific educational cases. Theoretical implications involve exploring how to sustain students' intrinsic motivation in the context of AI implementation.

KEYWORDS: intrinsic motivation, activity approach, Activity Theory, Artificial Intelligence, education

1. INTRODUCTION

The integration of Artificial Intelligence (AI) in education has been significantly accelerated by recent pandemics, highlighting its utilities in various educational technologies such as learning analytics, educational data mining, and personalised learning experiences (Dogan et al., 2023; Pantelimon et al., 2021). Innovations like chatbot technology (Deng & Yu, 2023) and generative AI (Crawford et al., 2023) have proven essential in enhancing students' capacity to succeed by providing adaptive learning environments. Current research related to educational scholars addresses critical issues such as ethical concerns related to privacy and surveillance (Klimova et al., 2023), the integrity of academic content in the age of AI-generated material (Aguayo et al., 2024), and the practical challenges of adapting AI to support flexible teaching and learning activities (Yang et al., 2023). It is now recognized that AI's role has evolved from merely automating tasks to augmenting human capabilities in both learning and teaching, with systems capable of analysing extensive datasets to support intelligent decision-making (Ifenthaler & Schumacher, 2023). These issues are addressed because immediate and practical challenges associated with integrating technology into education call for first attention. They intersect with academic processes that require urgent attention due to technological advances and whose results can be quickly observed in practice, such as the assessment of student knowledge, the design of learning environments, the protection of privacy, and the enhancement of student skills through data-driven processes. At the same time, there is a noticeable tendency in current studies on the integration of AI in education to omit pedagogical fundamentals in its development (Dogan et al., 2023) and a need for an interdisciplinary perspective (Zhang & Aslan, 2021), leaving a range of relevant topics yet outside the scientific discussion. It

appears that a significant number of questions pertaining to pedagogical principles remain under-examined in the context of the application of AI in education. Among the observed topics are the grounding of AI in educational theories (Luckin, Cukurova, 2019) and the consideration of cultural factors influencing the learning process (Teng et al., 2021). This study focuses on the critical educational learning driver of intrinsic motivation. Its importance lies in the category of interest in a subject matter and in epistemological needs, which are shared by many classic and contemporary research studies in educational psychology (Sansone & Morgan, 1992; Ryan & Deci, 2000; Leontiev, 1936/2009; Wong et al., 2020). It is of paramount importance to address learners' intrinsic motivation in subject matter in AI-supported educational processes, as it has been demonstrated that intrinsic motivation leads to lifelong learning (Deci & Ryan, 2002) and general well-being (Howard et al., 2021). These are two primary goals of education in the post-pandemic era. This topic is of particular importance when considering educational scenarios where motivation may appear to be shaped by algorithm-driven learning paths or pre-designed scenarios (Cagnini et al., 2023). Therefore, the main objective of this study is to investigate how AI implementation interacts with the critical pedagogical and psychological mechanism of intrinsic motivation. This aim is targeted within a broader goal to identify key questions regarding AI implementation that arise within the global educational research community. This is achieved within the interdisciplinary framework of Activity Theory (AT), which allows the examination of AI implementation in education as a globally occurring activity in a systemic way across six categories: Subject, Object, Instruments, Labour Division, Community, and Rules. The study places particular emphasis on the relationship between Subject and Object, with a focus on intrinsic motivation, as informed by Alexei Leontiev and his followers. The novelty of the method lies in its

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application of AT to the topic in combination with a perspective of critical discourse analysis, an approach that has not yet been explored.

1.1 Activity approach in psychology

Vygotsky's framework, which emphasises that our interactions with the world are mediated through cultural and historical artifacts, has been of significant importance in understanding the socio-cultural context of learning and development (Vasileva & Balyasnikova, 2019). Building on these theoretical principles, Alexei Leontiev introduced the term "activity approach in psychology" (Miettinen, 2005) to highlight the significance of human activities as the essential unit of analysis in understanding psychological processes. He emphasised that activities are purposeful, meaningful processes directed towards goals and mediated by tools and symbols within a social context (Leontiev, 1978). Activities are sustained by motivation, a dynamic mechanism built on values and motives, with motives reflecting specific needs. To gain a deeper understanding of the nature of motivation, it is useful to reflect on the categories of the known Vygotsky mediational triangle. In this way, the relationships inside this triangle can be identified from the advancements of Alexei Leontiev. The vertices of this triangle represent three key categories: Subject, Object and Mediating Artifacts. The Subject is an individual or group involved in the activity. The Object is the motive and the goal of the activity, which may be a material object or an abstract concept like knowledge. It is crucial to note that the transformation of the Object through activity is of great importance, as it leads to outcomes that fulfil the needs. The motives of activity are categorised into two primary types: intrinsic and extrinsic. Intrinsic motives arise organically from the activity itself and evoke interest, driven by the Subject's epistemological needs. Extrinsic motives, on the other hand, are driven by external factors significant to the Subject (Leontiev, 1978). A motive and a goal are both fundamental and distinct concepts. A motive, which may be unconscious or misidentified, initiates an activity and links it to personal needs and values. In contrast, a goal is the desired outcome that the Subject aims to achieve, representing the "what" of an action, whereas the motive addresses the "why" (Leontiev, 2016, p.12). Although motives and goals are not identical, they can coincide when a Subject's conscious aspirations align with their underlying motivations. This is a particular case of learning activity (Leontiev, 2001, p. 453), where learning appears to be a driving motive and a goal at the same time. This leads to intrinsic motivation, when the motive reflects an epistemological need and the learning activity is happening for the sake of knowledge acquisition. In this case, we refer to sense-making, or intrinsic motives. Intrinsic motives are closely associated with the category of personal meaning (Leontiev, 2012), as personal meaning is the subjective value that an individual attaches to an activity. The sense-making motive helps to determine why a particular activity is important and meaningful to an individual at a deep level. When an activity is consistent with an individual's inner values and beliefs, it takes on personal meaning, which enhances motivation and promotes deeper and more meaningful participation in that activity. However, motives do not always match the goals. For instance, the motivation to study may stem from career advancement or self-assertion rather than a genuine interest in learning (Leontiev, 2016, p.13). In this instance, we are dealing with extrinsic motives that may accompany the activity, but which do not necessarily lead to a deep understanding or internal reflection of the subject matter. With regard to the concept of Mediating Artifacts, another significant

theoretical concept proposed by Alexei Leontiev is the distinction between three levels of activity. These levels include activities that are motivated by needs, actions that are goal-oriented, and operations, which are the actual tasks performed under specific conditions (Leontiev, 1978). Consequently, in the context of technological tools, these would align with the level of operations, as they serve as specific means of performing actions that depend on conditions and methods of execution.

1.2 Activity System Model

Building on Vygotsky-Leontiev theory, Engeström (1997) adopted the concept of expansive learning within activity systems, focusing on collective activity and the dynamics of change. Engeström's model is particularly valued for its effectiveness in analysing collaborative activity within groups and communities, viewing activity as a social, collective process. This perspective highlights how the division of labour distinguishes between the collective Object/motive and the individual goals of action (Vinogradova & Kotliar, 2006). It is used in research to observe and analyse relationships within system elements (Liu et al., 2020) and to identify contradictions within these systems (Schröder et al., 2022).

Engeström's activity triangle model consists of six components: Subject, Object, Tools, Labour Division, Community and Rules, where Labour Division refers to the distribution of roles among community members, Community refers to the community of actors, and Rules refers to the explicit or implicit guidelines that govern the actions. Although some researchers have noted a tension between the origins of the activity approach of its Russian founders and its empirical application in the West (Bakhurst, 2009), this research illustrates how these theories intersect, as both emphasise the crucial relationship between Subject and Object within their motivational structure. The clear definition of the Subject is crucial, as it influences all other components of the theory and is at the core of the activity system. Figure 1 shows the structure of educational activity based on these principles.

Note. the educational activity model. Source: Researcher's own elaboration (2024)
Figure 1. Educational activity model.

In Figure 1, the abbreviations correspond to the following concepts: PMn - Personal Meaning, PV - Personal Values, N - Needs, M - Motive, SI - Subjective Image, G - Goal, As - Actions, Os - Operations, S - Subject, T - Tools, O - Object, LD - Labour Division, C - Community, R - Rules. This was an elaboration based on the

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works of researchers in the fields of activity approach in psychology and education, including theorists such as Vygotsky, Alexei Leontiev, and Engeström.

The primary relationships in the model are:

a) Subject and Object, mediated by Tools: This illustrates how individuals or groups engage with goals under specific motives through Tools, which either enable or constrain interaction with the Object.

b) Subject and Community, mediated by Rules: This relationship demonstrates how individuals or groups interact with the broader Community, governed by Rules that may include formal laws or informal social norms.

c) Community and Object, mediated by the Labour Division: This shows how collective efforts to achieve the Object are organised within the Community, structured through the Labour Division.

Although these relationships are primary, they are involved in interactions with the rest of the components of the activity system. Ultimately, all elements are interconnected and mediated by others, emphasising the integrated nature of the system.

In this study, by centering students as Subjects within the educational system, we aim to examine the current state of research on AI in education in its relation to intrinsic motivation, having previously understood the role attributed to AI by educational researchers. In particular, the use of an AT as a background for this purpose makes it possible to identify the place that AI tools occupy in a global educational activity in a systemic way, highlighting the crucial relationship between the Subject and the Object in terms of intrinsic motivational aspects in the learning activity accompanied by AI tools. Thus, in this study, Subjects (S) refers to students within the global educational activity, the Object (O) of this educational activity is broadly defined as the acquisition of knowledge, such as conceptual knowledge and competence execution. Tools (T) refers to AI as a Mediating Artifact in the process of knowledge acquisition.

The questions to be answered are:

Q1: In the context of integrating AI into education, with students at the centre, what relationships are at the forefront? Which remain underexplored?

Q2: What are the main topics within each of these relationships?

Q3: What is the place of intrinsic motivation in the articles reviewed?

2. METHODOLOGY

The objective of this research was to apply Critical Discourse Analysis (CDA) to a literature review on AI and intrinsic motivation in education. The ultimate goal is to improve future perspectives on AI in education by critically examining the current state of the art on this topic (Dodgson, 2021), framed within AT. CDA is an interdisciplinary research method that examines how discourse shapes our understanding of phenomena (Johnson & McLean, 2020). In the context of this article, the focus is on how the phenomenon of AI is being appropriated in global educational settings, achieved by analysing the written discourse in high quality articles published in the SCOPUS database over the last five years. The Scopus database was chosen as the source for the search because it is particularly useful for identifying trends and

characteristics in specific research fields (Fonseca-Soares et al., 2022) and is highly recognized as one of the leading research databases, distinguished by its unique indexing and citation analysis features (Stuart & Petersen, 2022), and thus one of the most influential ones. The year gap was chosen due to the high rise of research on the topic of AI in education after the pandemics, as can be observed in Figure 2.
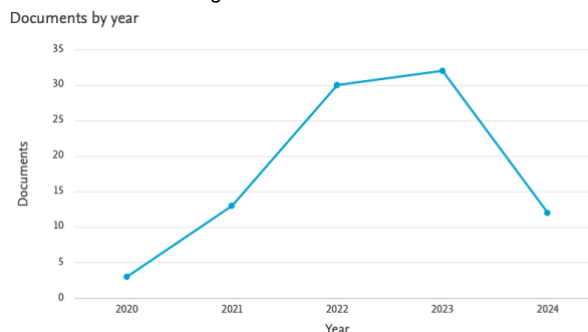
Figure 2. Increase in the number of articles published in the SCOPUS database on the topic of AI in education as of the search date February 29, 2024

Note. Figure 2 shows the significant increase in the number of scholarly articles on AI in education over the last five years, beginning with the onset of the pandemic.

The methodology for this research followed the procedure of the PRISMA method (Page et al., 2021), combining it with the CDA.

PRISMA stages.

1) Identification. A cross-disciplinary search for articles on AI in education was conducted in the SCOPUS database with the query: (TITLE (artificial) AND TITLE (intelligence) AND TITLE (education) AND ABS (competence) OR ABS (ability) OR ABS (skill) AND ABS (teacher) OR ABS (students)) AND PUBYEAR > 2019 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (PUBSTAGE, "final") OR LIMIT-TO (PUBSTAGE, "aip")) AND (LIMIT-TO (OA, "all")). The search was restricted to published and accepted open access articles. 90 scientific articles were identified: 88 in English, 1 in Spanish and 1 in Russian, which are the languages of competence of the researcher. 11 articles were excluded due to retraction, leaving 79 articles.

2) Screening. 79 titles and abstracts were screened with the aim of identifying studies that, in addition to the relationship between AI and education, focused on competence, ability or skill formation applied to empirical educational contexts, with knowledge acquisition as the primary objective. At this stage, 6 articles were excluded: 1 because it did not focus on knowledge acquisition, but on a chatbot service for career choice, and 5 were literature reviews, leaving 73 articles.

3) Eligibility. The full texts of the articles were examined, with inclusion criteria applied to studies that place students as Subjects at the centre of educational activity. In the main search in SCOPUS, two keywords were included that related to the Subjects of educational activity, namely teachers and students. The reason for this is that these actors are interrelated and could possibly include empirical data relating to students, while teachers are being studied. The main SCOPUS search made it possible to exclude articles that might focus on, for example, administrative personnel or parents. 4 full-text articles were excluded because they focused on teachers as the only Subjects in the educational activity with AI

and did not consider students as research subjects in the aims, results or discussion parts of the articles, resulting in 69 articles.

4) Analysis. At this final stage, all 69 full-text articles were included into the meta-analysis for identifying the covered relations between the categories of the educational activity model (see Figure 1). At this stage, the predominant relationship covered in the article was looked for, by examining objectives, results and discussion part of the documents. The main topics within the relationships types of the triangle were identified to provide a comprehensive overview of the discourse on AI implementation in education.

CDA.

In the first stage, all 69 articles were screened for addressing the topic of motivation and primary intrinsic motivation: whether the topic is observed or not, and how it is understood from the perspective of intrinsic and extrinsic motivation, including personal meaning, values, needs, types of motives and goals, as informed from the psychological perspective in AT. In the second stage, an additional search through the full texts of the articles studied was carried out using ChatPDF software, searching for keywords that could potentially be found in paragraphs related to the topic of motivation. These words include 'motivation', 'intrinsic', 'extrinsic', 'interest', 'engagement'. This allowed to correct some of the annotations made previously, as it made it possible to highlight all the parts of the articles in order to better understand the perspective that each researcher adopts with regard to the concept of motivation.

3.   RESULTS

3.1. Q1: In the context of integrating AI into education, with students at the centre, what relationships are at the forefront? Which remain underexplored?

Figure 3 graphically shows the distribution of articles by the coverage of relationship types between triangle categories, with Subject - Tools being the most covered. The relationships shown in grey were not identified as covered by the articles. The identification of the relationship in relation to each article can be found in a provided database in column U of the second sheet: https://doi.org/10.5281/zenodo.11898033.
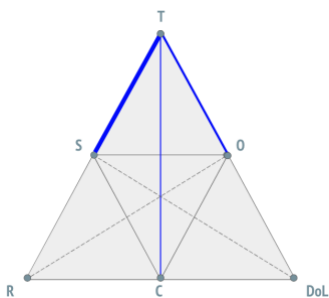
Figure 3. Identified relationships within AT as applied to student interaction with AI in education, with covered relationships shown in blue and uncovered relationships shown in grey

Note. Figure 3 illustrates the relationships identified by the analysis as either covered or uncovered in the articles analysed. The thickness of the blue lines indicates the coverage of articles focusing on each type of relationship.

Table 1 provides information on the exact number of samples identified in each type of relationship.

Relationship type	Number
Subject - Tools (S-T)	57
Tools - Object (T-O)	11
Tools - Community (T-C)	1

Table 1. Relationships type in numbers
Note. Table 1 shows the relationships identified in terms of numbers found.

3.2. Q2: What are the main topics within each of these relationships?

All the topics identified in the process of this analysis are presented in numbers in provided Excel in sheets 3 to 5: https://doi.org/10.5281/zenodo.11898033.

3.2.1.   Subject – Tools (S-T)

Within S-T relationship, the following topics are highlighted with the following number of mentions across all the corpus of the articles: practical activities enhancement (30 mentions), skills and competencies enhancement (25), personalised learning (14), adaptable environment (12), preparation for future professions with AI (10), interactive environment (9), responsive environment (7), problem-based learning enhancement (6), complex problem solving enhancement (5), real-world scenarios (5), content delivery (4), theoretical knowledge enhancement (3),   performance prediction (3), dynamic environment (2), automated learning (2); and the following topics each with one mention: well-being support, scientific research enhancement, negative AI influence, mental health improvement, loss of critical thinking, knowledge customization, immersive environment, ethical issues, designing solutions, decision making, creativity enhancement, behaviour recognition and attitudinal change.

The analysis of the impact of AI on education within this relationship shows that researchers focus on practical activities and the development of skills and competences, which are essential for students' academic and professional growth. These results are supported by the frequency with which they are mentioned in research articles, with the enhancement of practical activities and the development of skills and competences receiving the most attention. In addition, personalised learning, highlighted by its adaptability to individual student needs, increases the effectiveness of education, making AI a valuable tool for tailoring learning experiences to different student populations.

AI also plays a crucial role in preparing students for future careers, especially as digital technologies become increasingly important in different sectors. This preparation includes not only understanding AI, but also using AI tools to solve complex problems and improve task efficiency. The dynamic, interactive and responsive learning environments created by AI contribute to a more attractive educational experience. These environments support innovative teaching strategies such as problem-based learning, further enhancing students' ability to tackle real-world challenges.

Despite the positive impacts, the integration of AI in education also raises concerns, including the potential loss of critical thinking skills and ethical issues. Overall, AI is seen as a significant enhancer of educational practices, developing new skills and preparing students for a technologically advanced future, although its integration needs to be carefully managed to address potential challenges.

3.2.2. Tool - Object (T-O)

Within the T-O relationship, the following topics are mentioned once each: AI system development, application of complex calculations, big data analytics, data analysis methods, data-driven method for skills development, deep learning algorithms for pose estimation, development of AI interactive methods, dynamic data collection process, intelligent detection hardware, movement tracking, multidimensional self-classification algorithms, prediction of performance and retention, regression models.

These results reveal a strong emphasis on the development of tools and methods that underpin the application of AI in education. This relationship specifically highlights how different AI tools and techniques, such as AI system development, big data analytics and deep learning algorithms, are applied to tasks and outcomes related to student learning and performance. Each topic, including complex calculations, data analysis methods, and dynamic data collection processes, is mentioned once, suggesting a broad but not in-depth exploration of how AI technologies are developed and used to refine and optimise educational processes and outcomes.

The T-O relationship's focus on development topics underscores the advancement of AI technologies to enhance educational environments. For example, the development of AI interactive methods and intelligent recognition hardware demonstrates a focused approach to creating responsive and adaptive learning systems. In addition, specialised applications such as pose estimation algorithms and multidimensional self-classification algorithms demonstrate the ability of AI to address very specific educational tasks, such as tracking movement in physical education or tailoring student assessment. Taken together, these topics paint a picture of an evolving educational landscape in which AI tools are intricately designed to meet diverse educational practical applications, driving innovation that is directly applied to improving student learning experiences and performance metrics.

3.2.3. Tools - Community (T-C)

The T-C relationship covers three topics in one article: the development, modification and sharing of AI technology within a community.

This finding shows that AI technologies are not only used, but also adapted and improved through feedback loops involving different community stakeholders. This collaborative approach ensures that the tools evolve in response to the specific educational and developmental tasks of the community. By adopting these technologies, the community is actively involved in shaping how AI is implemented.

3.3. Q3: What is the place of intrinsic motivation in the articles reviewed?

The performed analysis is presented in the provided database in the second sheet in column V: https://doi.org/10.5281/zenodo.11898033.

The analysis of 69 articles allows us to conclude that in 56 research papers motivation is seen as extrinsic, which implies a greater involvement of students in the learning process due to increased interactivity (Zhao & Gao, 2023) and adaptability of the content (Yang et al., 2020). Through text analysis, it is clear that this type of motivation is driven by motives-stimuli, such as personalised learning environments (Bulathwela et al., 2024), which in fact means that motivation in this case is secondary to the AI implementation and is guided by the AI. From this corpus of articles,

which in fact treats the concept of motivation as extrinsic, one article highlights the disadvantages that the use of AI can have, especially on critical thinking and problem solving skills (Segbenya et al., 2023). One article is critical of the type of motivation supported by AI, suggesting a negative impact on student motivation, as the intrusive or manipulative use of AI could potentially demotivate students by undermining their autonomy or creating an overly controlled educational environment (Ivanov, 2023). In two articles (Cheng et al., 2020; Krive et al., 2023), the authors explicitly talk about the motivation directed towards learning AI tools, so that knowledge of AI manipulation becomes an Object rather than a tool in terms of AT. One article outlines the category of personal relevance, which is important for the concept of intrinsic motivation, although it is not really clear what is meant by this concept in its empirical application (Su & Zhong, 2022), and this type of motivation is still considered extrinsic. Only one article in the medical field talks about values when interacting with AI in education (Cornwall et al., 2023).

Only one article makes a clear distinction between intrinsic and extrinsic motivation (Kim, 2023), as understood in the framework adopted in this research. Intrinsic motivation is described in this paper as driving students to involve in an activity for its own sake, out of interest or enjoyment of the task itself, without external pressure or stimulation. In this article, AI interaction and its effects are seen as secondary to intrinsic motivation, although the latter can be influenced by AI.

In twelve articles, the textual analysis did not allow to identify their connection with the concept of motivation, as no topic of engagement with the material, internal or external interests while interacting with AI is clearly discussed.

Another observation that can be made from the analysis of the articles is that the term "needs", which is extremely important when talking about intrinsic motivation in terms of AT, seems to be used in most of the papers almost as a close synonym for "requirements", or "preferences", rather than referring to a person's epistemological needs. The latter encompasses the fundamental human drive to seek explanations, understandings and justifications that form the basis of our knowledge of the world. This need drives inquiry and curiosity, leading individuals to question how we know what we know, the certainty of that knowledge, and the methods by which that knowledge is acquired. In the context of the revised articles, a need can be understood as the specific requirements or preferences that individual students may have for their learning process, which, when met, enhance their educational experience by making it more attractive, which is quite different from its epistemological meaning.

4. DISCUSSION

The analysis of the results brought to the following findings:

4.1. In the system of educational activity, the main focus is on enhancing students' learning with AI, followed by development of intelligent systems and the impact of educational communities on AI

As can be observed from Table 1 and results reported in section 3.2 of this article, the predominant interests of the researchers are concentrated around the topics of technological learning enhancement, systems development and one research regarding the community impact on AI adaptation. These topics are of high interest in the research field due to their significant practical

benefits for education. This aligns with the prevailing trend in AI research in education, as elucidated by Yang et al. (2023), and is in accordance with the research of Pantelimon et al. (2021), Dogan et al. (2023) and Crawford et al. (2023). In the S-T-O triangle, the S-T relationship is particularly studied extensively as it captures how students interact directly with AI tools, such as learning management systems and AI tutors, which are instrumental in transforming the learning experience. This relationship attracts the most research attention as it directly correlates with immediate improvements in learning outcomes. Similarly, the T-O relationship is widely covered because it reflects the development of AI tools and their influence on educational content and processes, demonstrating how AI can personalise learning and improve assessment accuracy.

Conversely, as shown in Figure 3, many relationships remain under-explored. Among these is the central relationship, which is the focus of this study: the S-O relationship of the S-T-O triangle. Firstly, this relationship, mediated by AI tools, does not occupy a major place in the examined articles. Secondly, there is a clear necessity to distinguish between extrinsic and intrinsic types of motivation according to the role that AI plays in educational processes, viewing AI stimuli at the operational level. It is also necessary to consider AI implementations in a broader context of students' epistemological needs, centring on personal meaning and values in educational activities. This finding aligns with the opinion expressed by Dogan et al. (2023) about the lack of attention to the pedagogical foundations of learning while interacting with AI. As for other potential questions to explore, the interdisciplinary perspective of AT allows for the examination of various under-examined questions related to AI implementation, supporting the opinion of Zhang and Aslan (2021) on the usefulness of interdisciplinary methods applied for this purpose. As AT allows to observe, some interesting aspects to explore could revolve around the Labour Division. These relationships are likely less studied, primarily due to the complex and indirect nature of their impact on immediate educational outcomes and because they involve broader systemic and cultural elements (Engeström, 1997) that do not yield directly observable impacts on activity efficiency yet, due to the short period of AI adoption in education and the lack of empirical data on these topics. Another essential relationship to study could be the S-T-C-R dynamics. This relationship overlooks crucial aspects of AI integration, such as how these tools align with or challenge existing educational norms and regulations within communities concerning specific subjects. Understanding this relationship would enable us to see how societal norms and cultural values shape the adoption and use of technology in educational settings, providing insights into how different communities perceive and integrate AI, which can vary widely based on cultural, socio-economic, and educational factors. The study of the S-T-O-R relationship is also vital for ensuring that educational practices and AI technologies comply with existing educational standards and regulations. This includes adherence to data privacy laws, ethical standards, and accreditation requirements. Understanding this relationship helps in designing legal frameworks that govern AI systems. As educational AI systems evolve, the requirements from educational professionals and the skills needed to fulfil these roles will also change, highlighting the necessity of research on positioning teachers as central subjects in educational activity. All these results indicate that interdisciplinary perspectives are crucial when examining educational systems. Under such frameworks, particularly the AT framework, more unexplored topics in AI implementation in education can be identified, beyond surface-level issues such as cultural aspects or alignments with pedagogical theories (Luckin and Cukurova, 2019; Teng et al., 2021).

There is a compelling need to shift the focus of research toward these underexplored relationships in order to achieve a comprehensive understanding of the role of AI in the global educational system. Such a shift is necessary because an understanding of the socio-cultural and regulatory contexts of AI use is essential for ensuring that its integration is ethical, equitable, and aligned with long-term educational values. This more comprehensive approach will enable stakeholders to anticipate and regulate the impact of AI technologies on educational ecosystems in a more effective manner, ensuring that they support rather than disrupt the educational process. By embracing this expanded focus, researchers and educators can foster an educational environment that leverages AI to enhance learning activity, while addressing the epistemological needs of students, cultivating values, influencing meaning in education and upholding standards of fairness, privacy, and inclusivity.

4.2. Motivation in the educational context of students interacting with AI is predominantly viewed as extrinsic, with a lack of emphasis on intrinsic aspects, personal sense, meaning, and the epistemological needs of students

As demonstrated in section 3.3 of the Results, an analysis of the topic of motivation from the perspective of AT (Leontiev, 1978; Leontiev, 2001) reveals that intrinsic motivation, defined as a mechanism that arises from the activity itself and is driven by epistemological needs (Leontiev, 1978), is inadequately addressed in the context of AI implementation in education. Categories such as personal sense and meaning (Leontiev, 2012), as well as epistemological needs, are almost not discussed. In contrast, although AI applications are predominantly observed at the operational level of educational activity (Leontiev, 1978), the focus is shifted away from intrinsic topics towards direct and attractive involvement with AI tools or guidance by them in the learning process. The focus on external motivation in the context of AI implementation is not an unexpected result if viewed within the framework of AT, where tools are estimated to play a role of a Mediating Artifact in the process of knowledge acquisition. While AI is capable of augmenting human possibilities by immediate analysis of various datasets, as stated in (Ifenthaler & Schumacher, 2023), it is always assumed that it is a Subject who augments the possibilities of the AI first. A somewhat unexpected outcome of the research is the actual blending of intrinsic and extrinsic motivation concepts and a topic that has been relatively under-researched: the limitations and risks associated with AI. These risks may vary depending on the specific discipline in which AI tools are being applied. As evidenced by the results presented in Section 3.2 of this article, the topic of personalised and adaptive learning has been extensively explored in the corpus of articles under consideration. In relation to intrinsic motivation as described by Alexei Leontiev, it seems challenging to discuss the possibility of intrinsic motivation within the context of such limitations. In light of the fact that learning and motivation are guided in such a case, it would be inappropriate to discuss personal epistemological needs, sense and motivation, which are guided by created systems. It is possible that these scenarios may influence intrinsic motivation, although this is a matter for further investigation. The systems may be biased to tailor content to the learner's perceived requirements and preferences (or needs, as stated in most of the research papers), thus improving efficiency and involvement through customised feedback and recommendations. While this approach

can enhance learning productivity and accuracy, it would do so according to an estimated learning path, rather than according to the path that arises from the learning choices made by students. Another intriguing unexplored topic in relation to this question is the investigation of the problem of conscious, unconscious and misleading motives in learning activity while accompanied by AI. As stated in AT theory, the Object, which corresponds to knowledge acquisition in a broader sense in this research, transforms under the motive. Therefore, it is important to help students identify the right motives and epistemological needs, and to set goals in order to ensure the quality of the acquired knowledge.

The majority of the examined research addresses motivation as extrinsic, or driven by external stimuli (Leontiev, 2001), rather than by an interest in the activity itself. In the context of the present research, it has been demonstrated that students are primarily involved with learning activities for reasons other than epistemological curiosity or a desire to learn. Instead, they are motivated by the desire to interact with technology or to meet the expectations set by educational software. While extrinsic motives can be effective in encouraging certain behaviours or achieving specific short-term goals, they may not foster a lasting commitment to learning activities or the development of a deeper interest in the subject matter. This perspective suggests that the constant interaction with tools without centering the educational activity on intrinsic factors may lead to boredom and abandonment of the activity. Similarly, the same effect could be provoked by adaptive and personalised learning, as these strategies supposedly would be limited in challenging the students' capacities and cognitive abilities. However, this should be an important scenario in developing students' critical thinking and a lifelong learning ability.

It is of paramount importance to emphasise the encouragement of epistemological needs and personal values in students, in order to foster more profound and meaningful learning experiences. When educational approaches are designed to cater to students' epistemological needs, by encouraging them to question the foundations and validity of their knowledge, it cultivates critical thinking skills that are invaluable beyond the confines of formal education. Furthermore, this focus also supports the development of lifelong learning habits, which are essential in today's fast-evolving world where continuous skill acquisition and adaptability are paramount. Furthermore, by assisting students in comprehending the rationale behind their knowledge acquisition, we facilitate their autonomy and ethical decision-making in their learning processes. In this context, it is of paramount importance to reflect on the circumstances and methods for implementing adaptive and personalised learning, as this guidance may potentially diminish the autonomy of the students. Studying independently on a pre-designed path eliminates the possibility of personal conscious and random choice, which is essential for fostering autonomy in the learning process. Furthermore, students must be presented with challenges in their learning process in order to develop new skills, competencies and knowledge. While extrinsic motives can be beneficial in any human activity, it is essential to prioritise intrinsic motivation and to encourage students' epistemological curiosity in order to create comprehensive, long-lasting educational outcomes and to develop thoughtful, inquisitive, autonomous life-learners.

5. CONCLUSIONS

The primary objective of this study was to investigate the extent to which intrinsic motivation is present in the global context of AI implementation in education, while also identifying the key topics regarding AI that researchers deem important and those that remain underexplored. The study lead to the following findings: a) In the system of educational activity, the main focus is on enhancing students' learning with AI, followed by the development of intelligent systems and the impact of educational communities on AI; b) Motivation in the educational context of students interacting with AI is predominantly viewed as extrinsic, with a lack of emphasis on intrinsic aspects, personal sense, meaning, choice, and the epistemological needs of students.

Future theoretical research should concentrate on the intrinsic motivational aspects of AI integration in education, with a view to cultivating epistemological needs, personal meaning, sense and the question of choice. This entails the design of AI systems and the identification of an appropriate role for them in a manner that would facilitate genuinely self-directed and inquiry-based learning, enhancing students' autonomy through the possibility of a personal choice. Furthermore, comprehending the long-term effects of AI on both intrinsic and extrinsic motivation is crucial. It is of the utmost importance to differentiate between these two types of motivation and to identify an appropriate role for AI tools in each specific disciplinary context.

For practical implications, it is essential that students receive training on the foundations of AI, the principles of its work, and on AI as a supplementary tool that enhances and expands traditional learning techniques. This should emphasise the conscious understanding of the potential transformative effects of AI on the personal learning paths of students, thereby enhancing personal responsibility for learning. It is therefore necessary for teachers to undergo professional development training in order to ensure that they are able to integrate technology effectively with pedagogy and psychology.

A limitation of this study is that different disciplines and educational levels have not yet been considered. This is primarily due to the scarcity of quality research in the last five years on AI implementation in education regarding these characteristics. A more detailed analysis in the future will assist in a better understanding of the questions surrounding AI implementation in education. An interdisciplinary approach to researching educational systems in a systemic manner, as permitted by AT, appears to be an effective method for comprehensively understanding this topic in conjunction with all potential contexts of AI application.

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UNINT LA MOTIVACIÓ I LA IA EN EDUCACIÓ: UNA PERSPECTIVA DE LA TEORIA DE L'ACTIVITAT

Després de la pandèmia, la investigació sobre Intel·ligència Artificial (IA) en educació ha augmentat a nivell mundial. Pocs estudis abans de la pandèmia van abordar la motivació intrínseca als estudiants, crucial per a la retenció del coneixement. Aquest estudi analitza com es tracta aquest tema en investigacions recents, fent una revisió de la literatura i una anàlisi crítica del discurs sota el marc teòric de la Teoria de l'Activitat (AT). L'objectiu és identificar la cobertura de les relacions entre nodes al sistema d'activitat educativa, amb especial atenció al subjecte (estudiants) i l'objecte, que reflecteix la naturalesa motivada de l'activitat humana. L'anàlisi va incloure 69 articles de Scopus publicats des del 2020. Els resultats mostren la cobertura d'algunes relacions, com Subjecte-Eines (interacció dels estudiants amb IA), Eines-Objecte (desenvolupament d'IA) i Eines-Comunitat (adaptació de la IA) a la comunitat educativa). La relació Subjecte-Objecte roman inexplorada. Les implicacions pràctiques inclouen un reenfocament en la motivació intrínseca, emfatitzant necessitats epistemològiques, significat i elecció, avaluant els beneficis i els riscos de la IA en casos educatius específics. Les implicacions teòriques impliquen explorar com mantenir la motivació intrínseca dels estudiants en el context de la implementació de IA.

PARAULES CLAU: motivació intrínseca, enfocament d'activitat, Teoria de l'Activitat, Intel·ligència Artificial, educació.

UNIENDO LA MOTIVACIÓN Y LA IA EN EDUCACIÓN: UNA PERSPECTIVA DE LA TEORÍA DE LA ACTIVIDAD

Después de la pandemia, la investigación sobre Inteligencia Artificial (IA) en educación ha aumentado a nivel mundial. Pocos estudios antes de la pandemia abordaron la motivación intrínseca en los estudiantes, crucial para la retención del conocimiento. Este estudio analiza cómo se trata este tema en investigaciones recientes, realizando una revisión de la literatura y un análisis crítico del discurso bajo el marco teórico de la Teoría de la Actividad (AT). El objetivo es identificar la cobertura de las relaciones entre nodos en el sistema de actividad educativa, con especial atención al Sujeto (estudiantes) y el Objeto, que refleja la naturaleza motivada de la actividad humana. El análisis incluyó 69 artículos de Scopus publicados desde 2020. Los resultados muestran la cobertura de algunas relaciones, como Sujeto-Herramientas (interacción de los estudiantes con IA), Herramientas-Objeto (desarrollo de IA) y Herramientas-Comunidad (adaptación de la IA en la comunidad educativa). La relación Sujeto-Objeto permanece inexplorada. Las implicaciones prácticas incluyen un reenfoque en la motivación intrínseca, enfatizando necesidades epistemológicas, significado y elección, evaluando los beneficios y riesgos de la IA en casos educativos específicos. Las implicaciones teóricas implican explorar cómo mantener la motivación intrínseca de los estudiantes en el contexto de la implementación de IA.

PALABRAS CLAVE: motivación intrínseca, enfoque de actividad, Teoría de la Actividad, Inteligencia Artificial, educación.