



Reasoning Competency in the AI-Enhanced Higher Education

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Abstract. This conceptual piece explores the notion of *Reasoning Competency* (RC) within the context of higher education (HE), particularly in the era of AI-enhanced learning environments. It examines how AI technologies can reshape the way reasoning is taught, learned, and applied, emphasizing the importance of RC as a core educational outcome. The paper considers *reasoning* as a dynamic process—an evolving skill set that spans *inferential thinking* through to *reasoning* itself. It probes the ethical and moral dimensions of AI-assisted reasoning, questioning how algorithms influence decision-making and knowledge construction, and how HE can foster a critical engagement with these technologies. The piece proposes a novel idea of *human-AI collaboration* in the educational setting, suggesting that AI can both augment and challenge human reasoning capacities. In this collaboration, the human learner remains central, guided by the pedagogical imperative to develop RC as a way to navigate increasingly complex intellectual terrains. As AI technologies redefine the boundaries of intellectual work, the paper argues that a robust understanding of RC is essential for learners to effectively interact with both AI tools and human knowledge, ensuring that students attain reasoning competency at a satisfactory level. The use of AI tools should therefore be optimized in such a way that students are not deprived of opportunities to develop reasoning competency. Such tools should thus offer more avenues for the students to become competent in reasoning.

Keywords: Reasoning Competency, Human-AI Collaboration, Higher Education

1 Introduction

As higher education institutions aim to prepare students for complex problem-solving and decision-making in an increasingly interconnected and rapidly evolving world, the development of robust reasoning abilities has become paramount [1]. This author, for example, highlights relational reasoning as a crucial cognitive skill that involves recognizing and applying relationships between different concepts. This type of reasoning helps students make connections and integrate information more effectively. Students vary widely in their cognitive abilities, including their capacity for reasoning. These differences can affect how they approach learning tasks and perform on assessments. Research has also been done on what constitutes ‘argumentative competence’, defining it as the ability to construct, analyze, and evaluate arguments effectively [2]. This competence also involves skills such as reasoning, evidence evaluation, and the ability to articulate and defend one's position. Argumentative competence is highlighted as a crucial skill for academic success and critical thinking. It is essential for engaging in academic discourse, problem-solving, and developing well-rounded reasoning abilities.

Against this backdrop, this conceptual piece brings forth a nuanced treatment of the notion of ‘reasoning competency (RC)’ in the context of Higher Education (HE). Beginning with an explanation of the term ‘reasoning’, this piece goes onto position ‘reasoning’ in the context of Artificial Intelligence (AI)-enhanced HE. Considerations of ethical and moral aspects of AI-assisted reasoning will then foreground a discussion on RC’s pedagogical emphasis. The theorization will then extend to ‘the making of rationality’ from ‘inferential thinking’ through ‘reasoning’. The novel idea of human-AI collaboration in the HE environment and the centrality of RC in such an environment will then be argued for in conclusion.

2 Reasoning as a competency

Subsumed under argumentative competency, reasoning competency refers to the ability to think logically, make sound judgments, and solve problems effectively. It is often conceptualised as that which aims at the development of a professional who can apply integrative thinking to analyse, synthesize, and solve problems, while continu-

ously attaining the cognitive skills required for scientific, critical, and systemic thinking [3] .

It thus encompasses critical thinking, analytical skills, and the capacity to evaluate arguments and evidence. In the context of higher education, reasoning competency is not merely an academic exercise but a fundamental skill that shapes students' capacity to navigate complex challenges in both their professional and personal lives. Higher education aims to prepare students for the multifaceted and dynamic nature of the modern workforce. In an era characterized by rapid technological advancements, globalization, and increasing complexity in various fields, the ability to reason effectively becomes crucial[4]. Professionals are frequently required to analyse intricate data, anticipate potential challenges, and devise innovative solutions. Reasoning competency equips students with the tools to approach these problems systematically, consider multiple perspectives, and make informed decisions. This skill is particularly essential in fields such as engineering, science, business, and law, where precise and critical thinking can significantly impact outcomes.

As an aspect of reasoning, 'analytical thinking' involves breaking down complex information into manageable parts, identifying patterns, and understanding relationships. Critical thinking, on the other hand, involves evaluating arguments, questioning assumptions, and assessing evidence [5]. By developing these skills, students are better able to engage with scholarly literature, critique existing theories, and contribute to ongoing debates within their disciplines. These competencies are vital for conducting research, formulating hypotheses, and presenting coherent arguments, thus enhancing the overall quality of academic work.

In a rapidly changing world, the ability to reason effectively supports lifelong learning and adaptability. As new challenges and opportunities emerge, individuals must be able to continuously acquire and apply new knowledge. Reasoning competency enables students to approach new information with a critical mindset, assess its relevance, and integrate it into their existing understanding [6]. This adaptability is crucial for career progression and personal growth, as it allows individuals to navigate

changes in their professional environments and stay relevant in their fields. We live in an era of information overload, where individuals are constantly bombarded with vast amounts of data from diverse sources. The ability to reason critically helps students sift through this information, discern credible sources, and make informed judgments. In a world where misinformation and fake news are prevalent, reasoning competency becomes a crucial tool for distinguishing between reliable and unreliable information[7]. This skill is essential for making informed decisions about health, politics, and other areas that impact daily life.

Effective reasoning also improves communication and collaboration skills. Being able to articulate one's reasoning clearly and logically helps in presenting ideas persuasively and engaging in constructive discussions [8]. Collaborative projects often require team members to debate ideas, resolve conflicts, and come to consensus. Reasoning competency aids in these processes by providing a framework for evaluating different viewpoints and working towards common goals. Reasoning competency is therefore a cornerstone of higher education that influences a wide range of academic and professional outcomes. As such, developing and nurturing reasoning skills should be a central focus of educational practices and curricula, ensuring that students are well-equipped to meet the demands of the modern world [9].

3 Theorising ‘reasoning’ in the context of AI-enhanced HE

Arguing in defence of the need for reasoning competency in higher education, even in the age of advanced AI, requires emphasizing the unique human qualities and capabilities that complement and enhance AI's potential [10]. AI systems, despite their advanced capabilities, often lack nuanced understanding and contextual awareness. While AI can process vast amounts of data and perform complex calculations, it typically operates based on predefined algorithms and patterns. Human reasoning, on the other hand, involves interpreting context, understanding subtlety, and applying judgment based on experience and ethical considerations. Higher education cultivates these critical thinking skills, which are essential for interpreting AI outputs within broader social, cultural, and ethical contexts [11].

The ways in which Large Language Models (LLMs), such as Generative Pre-trained Transformer (GPT) models, are transforming qualitative research and the reasoning competency that characterises such research have been noteworthy. These models can generate, analyse, and interpret text data, potentially augmenting researchers' capabilities in data coding, thematic analysis, and generating insights [12]. The potential benefits of LLMs in qualitative research, such as increased efficiency in handling large volumes of text, uncovering patterns, and assisting in the synthesis of complex data have also been widely acknowledged (p.10). LLMs can support researchers in identifying themes and generating preliminary analyses. Concerns about the accuracy of AI-generated insights, the potential for bias, and the need for careful interpretation of AI outputs have also been raised by researchers [13]. The reliance on LLMs raises questions about the depth and nuance of qualitative analysis traditionally performed by human researchers. The integration of AI tools may alter the cognitive processes involved in qualitative analysis, potentially affecting how researchers approach data interpretation and decision-making [12]. The importance of maintaining rigorous methodological standards and ethical considerations when incorporating AI tools into qualitative research cannot be overemphasised.

The point here is that, within the rigorous methodological conventions of academic research, RC is significant. In the context of the AI-enhanced research practices, however, such a competency may be overlooked, much to the detriment of novice researchers' development.

4 AI-assisted reasoning that foregrounds ethical and moral decision-making

Artificial intelligence (AI) systems with advanced reasoning capabilities can mimic human decision-making processes [14]. AI systems that exhibit high-level reasoning abilities, including the capacity for complex problem-solving and decision-making are hence noteworthy.

Such systems can replicate certain aspects of human decision-making, even though they often struggle with the subtleties and unpredictability inherent in human decisions (p.8). While AI can be a valuable tool, there are still significant gaps in fully replicating human decision-making complexity. AI's ability to reason can be seen in this context. Also, AI lacks inherent ethical and moral reasoning [15]. It follows the guidelines set by its programming and the data it has been trained on, which may not fully capture ethical complexities or societal values. Human reasoning is necessary to address ethical dilemmas and make morally sound decisions, especially in areas where AI might not have clear guidance. For instance, decisions about AI deployment, privacy concerns, and the societal impact of technology require human judgment that considers ethical implications beyond mere data analysis.

AI excels in pattern recognition and optimization but is generally limited in terms of creativity and innovation [16]. Reasoning competency in humans encompasses the ability to think creatively, generate novel ideas, and approach problems from unique angles. Higher education encourages creative problem-solving and innovation, areas where human reasoning can complement AI by providing insights and solutions that AI may not have anticipated or generated. The AI's divergent thinking as a cognitive process of coming up with diverse and innovative ideas in response to a problem is significant [17]. This type of thinking is crucial for creative tasks where there is no single correct answer. Despite significant advancements in AI, the best human performers still outperform AI systems in creative divergent thinking tasks. Humans tend to produce more diverse, original, and contextually relevant ideas compared to AI. There are several limitations of AI in creative tasks. These include the AI's reliance on existing data patterns and algorithms, which can restrict its ability to think outside the box or generate truly novel ideas. AI systems often struggle with the nuances and subtleties that characterize human creativity (p.6). Human mind still surpasses AI in tasks requiring creative divergent thinking, highlighting the ongoing challenge of replicating human creativity in artificial systems (p.9)

5 Pedagogical emphasis on reasoning in the context of AI enhanced learning environments

This article has so far dealt with the notion of reasoning as a competency, historically fostered in educational settings. Its decision-making power in an AI-enhanced environment and hence the need for securing it on an ethically sound foundation was then discussed. Let us now turn to the idea of ‘pedagogically emphasised reasoning competency’, envisaged in an AI-enhanced learning environment.

How the advent of generative AI technologies, such as advanced language models, is reshaping the landscape of education characterises the current pedagogical discourses. The implications of these technologies on the processes of teaching and learning emphasizes the need for thoughtful consideration of the questions and challenges they present [15]. The generative AI technologies such as the large language models that can produce text, solve problems, and generate content based on user input are becoming increasingly prevalent in educational settings. Generative AI has the potential to transform teaching by automating routine tasks such as grading, providing instant feedback, and offering personalized learning resources. It can assist teachers by generating instructional materials, designing curriculum elements, and even suggesting pedagogical strategies [18].

However, there are challenges associated with integrating AI into teaching [16]. The quality and accuracy of AI-generated content, the potential for reinforcing biases, and the risk of diminishing the role of teachers in guiding and mentoring students have hence become systemic concerns. For students, generative AI can offer new learning tools and resources. It can provide customized explanations, generate practice problems, and support individualized learning paths. AI-driven tutoring systems can adapt to students’ needs, potentially enhancing their learning experiences. The risk of students becoming overly reliant on AI for answers and solutions, which could undermine their development of reasoning skills, critical thinking and problem-solving skills is ever more genuine [15]. There is concern that AI might encourage surface-level learning rather than deep understanding. With the rise of generative AI, the traditional goals of education may need to be re-evaluated. There are increased calls for fostering skills that complement AI, such as creativity, critical thinking, and emotional intelligence, rather than simply transmitting information (p.55). It emphasizes the

importance of asking the right questions about how AI is used in education. Questions about the ethical implications, the role of human judgment, and the impact on learning outcomes are crucial for ensuring that AI enhances rather than diminishes educational quality. It also points out the need for proper training for educators to effectively integrate AI tools into their teaching practices.

ChatGPT can offer personalized support to learners by providing tailored explanations, answering questions, and adapting to individual learning needs [19]. This personalization can help students grasp complex concepts at their own pace [20]. The tool provides around-the-clock availability, allowing learners to access educational support anytime, which can be particularly beneficial for students who need help outside regular classroom hours. ChatGPT can offer instant feedback on assignments and questions, helping students quickly identify and address their mistakes or gaps in understanding (p.6). Since the model generates responses based on patterns in data rather than verified facts, there is a risk of misinformation or incomplete answers [21]. ChatGPT may struggle with providing deep, contextually rich answers or engaging in complex discussions. Its responses are based on patterns in the training data, which might limit its ability to handle nuanced or advanced topics. However, its integration into educational settings must be carefully managed to address challenges such as accuracy, depth, and ethical concerns. By following best practices and continuing to research its impact, educators can harness the benefits of ChatGPT while mitigating its limitations, ultimately enhancing the learning experience [22].

Pedagogical emphasis on reasoning in an AI-enhanced environment is thus imperative. This is largely due to AI reducing the need for students to use their own reasoning techniques. We will now attempt to theorise the intricate ways in which ‘reasoning’ places itself conceptually between ‘inferential thinking’ and ‘making rationality’. Inference, reasoning and rationality thus become a processual order in which rationality is constructed [23].

Inferential thinking and reasoning – towards the making of rationality

The making of rationality starts with inferential thinking proceeding to reasoning and culminating in the assumption of a rational state of mind [5]. Inferential thinking and reasoning are fundamental processes in the development of rationality. Rationality, in this context, refers to the ability to think logically, make well-informed decisions, and draw conclusions based on evidence and sound arguments (p.222). It is a critical cognitive skill that enables individuals to navigate complex situations, solve problems effectively, and understand the world more coherently. Inferential thinking—the ability to make inferences, or draw conclusions based on available information—forms the core of rational decision-making and problem-solving.

The Role of Inferential Thinking

At the heart of inferential thinking is the ability to move beyond the immediately available facts to make sense of the unknown or the unclear. This often involves reasoning through probabilities, anticipating outcomes, and considering alternative possibilities [24]. For example, when a detective investigates a crime, they do not merely focus on the facts at hand; they also make inferences about what might have happened based on subtle clues, patterns, and context. Similarly, in everyday life, we constantly engage in inferential thinking when we make predictions about the future based on past experiences or when we read between the lines to understand unspoken implications.

Inferential thinking requires individuals to work with incomplete information. Often, we do not have all the data needed to form a definitive conclusion. Rationality, in this sense, is about managing uncertainty—employing logical reasoning to make the best possible inference given the evidence available [23]. This process is not purely mechanical; it involves intuition, judgment, and critical thinking to filter through assumptions, biases, and contradictions.

The Role of Reasoning

Reasoning in this context is the mental process by which individuals organize their thoughts, evaluate arguments, and draw conclusions. In the context of inferential thinking, reasoning involves connecting facts, hypotheses, and prior knowledge to create coherent narratives that explain or predict outcomes. There are several types of reasoning, such as deductive, inductive, and abductive reasoning, each of which plays a different role in inferential thinking [25]. Deductive reasoning involves starting with a general premise and deriving specific conclusions from it. It is a method of reasoning where if the premises are true, the conclusion must also be true. For example, in the syllogism "All humans are mortal; Socrates is human; therefore, Socrates is mortal," the conclusion follows necessarily from the premises. Inductive reasoning works in the opposite direction, starting with specific observations and forming general conclusions based on patterns or trends. For example, observing that the sun has risen in the east every day for your entire life might lead you to infer that it will continue to do so in the future. While inductive reasoning doesn't guarantee truth, it is highly valuable for making predictions and forming hypotheses. Abductive reasoning is about inferring the most likely explanation for a set of observations. It is often used in scientific discovery, diagnostic processes, and problem-solving. For example, a doctor diagnosing a disease based on a combination of symptoms might not have all the answers, but they infer the most probable cause based on their medical knowledge and reasoning [26].

6 Rationality and the Integration of Thinking with reasoning

The process of making rational decisions involves integrating inferential thinking with reasoning. Effective rationality requires that we balance logical thought with emotional awareness, context, and ethical considerations. The more skilfully we can manage this integration, the more effective we are at making rational choices. A person who excels in inferential thinking and reasoning is better equipped to weigh evidence, assess risks, and draw reasonable conclusions, even in the face of ambiguity and uncertainty [8].

Critical thinking is integral to the development of rationality[27]. It encourages individuals to question assumptions, evaluate evidence, and assess the validity of conclusions. In the absence of critical thinking, people may fall prey to cognitive biases, logical fallacies, or irrational judgments. Developing strong inferential reasoning skills not only helps in academic pursuits but also plays a vital role in making everyday decisions—whether in personal life, work, or governance.

Inferential thinking and reasoning are cornerstones in the construction of rationality. Through the continuous practice of drawing conclusions based on evidence, considering alternative explanations, and thinking through complex scenarios, individuals become more adept at making logical and informed decisions. Rationality is not simply about adhering to rigid rules but about being open-minded, flexible, and critical in one's thinking. By honing our inferential thinking and reasoning skills, we move towards a deeper understanding of the world and our place within it, making decisions that are more grounded in logic, evidence, and reason [27].

Human-AI Collaboration and the precarity of students' reasoning skills- some concluding thoughts

Effective collaboration between humans and AI requires reasoning skills to bridge the gap between human expertise and AI capabilities. Reasoning helps in effectively communicating with AI systems, interpreting their suggestions, and making informed decisions based on a combination of human insight and AI-generated data [13]. Higher education fosters these collaborative skills, preparing students to work effectively alongside AI technologies.

Questions on how AI can collaborate with human educators to enhance teaching and learning towards the advancement of reasoning skills have immense significance in the AI enhanced environment. AI tools can handle routine tasks, such as grading and feedback, freeing up educators to focus on more complex aspects of teaching, such as mentorship and personalized support [28]. Effective human-AI collaboration involves designing AI systems that complement and augment human capabilities rather than

replace them. The interaction should be synergistic, with AI providing support and insights that help educators and learners achieve their goals more effectively (p.125).

The concern that students' ability to reason might be lost with the use of ChatGPT and similar AI tools is valid, but the outcome largely depends on how these tools are integrated into educational practices [29]. Students might rely heavily on AI for answers without engaging deeply with the material themselves. This could lead to a superficial understanding of concepts and a diminished capacity to reason independently. If students use AI to solve problems or complete assignments without attempting to tackle the challenges themselves, they may miss out on developing critical thinking and problem-solving skills. If students frequently turn to AI for quick solutions, they might not practice the reasoning processes involved in analysing and solving problems on their own. The cognitive effort required to work through problems, develop arguments, and make decisions might be reduced, potentially impacting long-term cognitive development. AI models, including ChatGPT, can occasionally provide incorrect or biased information. Relying on these tools solely without critical evaluation can lead to misinformation and misunderstandings in addition to relegating the

While there is a potential risk that over-reliance on ChatGPT and similar AI tools might impact students' reasoning abilities, these risks can be mitigated with thoughtful integration and guidance [30]. By using AI as a supplementary tool rather than a crutch, and by focusing on practices that encourage critical thinking and active engagement, educators can help ensure that students continue to develop strong reasoning skills alongside the benefits provided by AI technologies. AI systems are limited by their programming and the data they are trained on, which means they can struggle with issues not well-represented in their training data or encounter challenges outside their designed parameters [31]. Human reasoning is crucial for dealing with these limitations, as it allows individuals to approach unforeseen problems, develop new strategies, and address scenarios that AI may not handle well.

While AI offers powerful tools for data processing and decision-making, it cannot replace the need for human reasoning. Higher education's emphasis on reasoning

competency equips individuals with the ability to make ethical decisions, think creatively, critically evaluate technology, and adapt to changing circumstances. In an increasingly AI-driven world, these human skills complement and enhance AI capabilities, ensuring that technology serves humanity effectively and responsibly [32]. AI, in this sense, complements human capacity to reason and hence does not replace one's unique ability to critique.

An effort is now made in this piece to present before the reader a logical synthesis of ideas presented so far. Reasoning is increasingly recognized as a crucial competency in today's educational, professional, and ethical landscapes. It serves as the foundation for rational decision-making, critical thinking, and problem-solving, all of which are essential for navigating the complexities of modern life. As artificial intelligence (AI) technologies continue to evolve, they offer both challenges and opportunities for enhancing reasoning, particularly in higher education, where the integration of AI can transform traditional pedagogies and decision-making frameworks. At its core, reasoning is the ability to analyse information, synthesize insights, and draw logical conclusions. It encompasses various forms, including deductive, inductive, and abductive reasoning, each of which plays a role in critical thinking and decision-making. As a competency, reasoning empowers individuals to evaluate arguments, challenge assumptions, and make informed decisions in a world often marked by uncertainty and complexity. In higher education, the development of reasoning skills is essential for students, as it equips them to approach problems systematically and think critically about both their academic work and their broader societal roles.

AI-enhanced higher education introduces new ways to support and develop reasoning abilities. Through intelligent tutoring systems, adaptive learning technologies, and data-driven analytics, AI can help personalize educational experiences and provide targeted feedback that sharpens students' reasoning skills [11]. Theorizing reasoning in this context involves understanding how AI can facilitate the development of cognitive competencies and how the role of the educator evolves. AI does not replace human reasoning but acts as a complementary tool, providing students with resources to refine their logical thinking and deepen their understanding of complex topics.

Moreover, the integration of AI in education prompts a rethinking of traditional pedagogical approaches. Educators are increasingly adopting AI tools to augment classroom learning, helping students tackle increasingly intricate problems with the support of intelligent systems [11]. This synergy between human cognition and AI highlights the potential for a more personalized, responsive approach to education, where reasoning is honed through direct interaction with advanced technology. AI-assisted reasoning also carries significant implications for ethical decision-making. As AI systems become more integrated into decision-making processes, they raise important questions about bias, fairness, and accountability. AI's ability to process vast amounts of data can help identify patterns and offer solutions to complex ethical dilemmas, but it also requires careful design and oversight to ensure that these systems align with human values and ethical standards. When AI assists in reasoning, it is crucial to consider how its outputs might influence human decisions and whether the system operates transparently, without reinforcing harmful biases.

In this regard, reasoning is not solely about logic and analysis; it is also about making morally responsible choices. The integration of AI in decision-making calls for a deeper focus on ethical reasoning, both in terms of the development of AI systems and in how individuals use these tools to make decisions that affect society.

In higher education, pedagogical emphasis on reasoning helps foster the critical thinking necessary for students to engage with AI systems in meaningful ways. Courses designed to enhance reasoning often focus on argumentation, problem-solving, and the evaluation of evidence [10]. When AI is integrated into such courses, it can support these objectives by providing real-time feedback, simulations, and problem-solving environments that challenge students to apply their reasoning skills. Furthermore, AI can also be used to create interactive learning environments where students engage in reasoning-based tasks, making the learning process more dynamic and personalized.

Inferential thinking, a key aspect of reasoning, is central to the development of rationality. It enables individuals to make conclusions based on available evidence and to

make decisions even when faced with incomplete or ambiguous information. The making of rational decisions, whether in everyday life or in complex professional settings, often involves integrating various types of reasoning—deductive, inductive, and inferential—to navigate uncertainty and achieve the best possible outcomes. AI-enhanced reasoning tools can assist in this process by helping individuals sift through vast amounts of information and identify patterns that might not be immediately apparent.

The collaboration between humans and AI in developing reasoning abilities holds transformative potential. While AI can assist in processing data and suggesting possible solutions, it is the human capacity for creativity, ethical reflection, and judgment that shapes the final decision-making process. Human-AI collaboration thus offers an opportunity to enhance reasoning abilities by combining human insight with AI's computational power [33]. Educators can use AI to identify areas where students struggle with reasoning, providing targeted interventions that help them build stronger cognitive skills. Moreover, as students interact with AI systems, they develop a more nuanced understanding of both human and machine reasoning, fostering a balanced approach to problem-solving and ethical decision-making.

7 Conclusion

Reasoning is a vital competency that drives rationality, informed decision-making, and ethical behaviour in an increasingly complex world. AI-enhanced higher education has the potential to significantly strengthen reasoning abilities by offering personalized, data-driven tools for learning. However, this also necessitates a careful consideration of the ethical implications of AI in reasoning processes. Ultimately, the most effective approach will involve a symbiotic relationship between human cognitive abilities and AI, fostering a more nuanced, informed, and responsible form of reasoning that prepares individuals for the challenges of the future.

Future research on reasoning, rationality, and AI in higher education can be advanced by exploring several key areas where these concepts intersect. Central to this is the development of frameworks that integrate AI-driven learning technologies with hu-

man cognitive abilities, particularly reasoning and ethical decision-making. As AI systems become more integrated into educational environments, research can focus on how these tools can help foster deeper inferential thinking and enhance various types of reasoning, such as deductive, inductive, and abductive reasoning, in students.

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