Jurnal Kejuruteraan 38(1) 2026: 01-14
https://doi.org/10.17576/jkukm-2026-38(1)-01

# From Blind Trust to Critical Inquiry: Epistemic Beliefs and Student Engagement with ChatGPT in Higher Education

Irfan Ahmed Rind[a*], Jahanghir Bhatti[b] & Kalaivani Chellappan[c]

[a]*Sohar University, Oman, and Sukkur IBA University, Pakistan*

[b]*Sohar University, Oman*

[c]*Universiti Kebangsaan Malaysia (UKM)*

[*]*Corresponding author: iahmed@su.edu.om*

*Received 20 June 2025, Received in revised form 11 October 2025*
*Accepted 11 November 2025, Available online 30 January 2026*

ABSTRACT

*Generative AI tools like ChatGPT are rapidly reshaping how students access and engage with knowledge. While these technologies can support learning, their influence depends heavily on students' epistemic beliefs—their views about the nature, source, and justification of knowledge. Research has shown that epistemic orientations shape whether learners critically interrogate or passively accept information, yet little is known about how this plays out in AI-mediated contexts, particularly in higher education settings outside the West. This study addresses that gap by examining how undergraduate students in Oman engage with ChatGPT through the lens of Hofer and Pintrich's (1997) epistemic belief framework. Using a qualitative interpretive approach, semi-structured interviews were conducted with thirteen undergraduate students from diverse disciplines to explore how their epistemic beliefs influenced their interactions with ChatGPT. The thematic analysis revealed four engagement patterns: Naïve Believers, Over-Reliant Users, Strategic Skeptics, and Critical Evaluators. These patterns reflect not only individual beliefs but also cultural norms, educational experiences, and workload pressures. The findings advance AI–epistemic beliefs scholarship by showing how cultural context and academic conditions shape trust, verification, and reasoning with AI outputs. The study argues for embedding AI literacy into curricula through strategies such as argumentation-based learning, claim–evidence coordination, and metacognitive scaffolding to foster critical digital literacy and prepare students for an AI-mediated knowledge environment.*

*Keywords: Epistemic beliefs; ChatGPT; generative artificial intelligence; critical digital literacy; higher education*

## INTRODUCTION

The rapid advancement of generative artificial intelligence (GenAI) technologies, particularly large language models (LLMs) such as ChatGPT, has transformed the way individuals access, process, and produce information. Since its public release in late 2022, ChatGPT has gained unprecedented popularity across educational contexts, offering users instant, coherent, and contextually relevant responses to a wide range of queries (Kasneci et al. 2023; OpenAI 2023). While these tools hold significant potential to enhance learning through personalised feedback, brainstorming support, and language assistance, their use also raises critical questions about epistemic trust, source evaluation, and the development of higher-order thinking skills (Perrault et al. 2023; Zawacki-Richter et al. 2019).

In higher education, students' interactions with GenAI tools are shaped not only by technical affordances but also by their epistemic beliefs, i.e., personal conceptions about the nature of knowledge and knowing (Hofer & Pintrich 1997; Schommer-Aikins 2004). Research shows that students with less developed epistemic beliefs often treat information from perceived authoritative sources, including GenAI, as certain and unquestionable (Rind & Ning 2024; Rind 2022; Ning, Rind & Asad,2020; Barzilai & Zohar 2012; Lee et al. 2023). Conversely, those with more sophisticated beliefs engage in verification, cross-referencing, and contextual analysis before accepting

information as valid (Greene et al. 2008; Kuhn & Weinstock 2002). Understanding these orientations is essential for educators seeking to foster responsible and critical engagement with AI-generated content.

The integration of GenAI into academic practices coincides with long-standing educational imperatives to cultivate critical thinking, information literacy, and reflective judgment (Facione 2013; Paul & Elder 2006). However, the immediacy and fluency of ChatGPT's responses may inadvertently reinforce superficial engagement, particularly for students under academic pressure or from educational systems that emphasize rote learning (Luckin et al. 2022; Tang et al. 2022). This is particularly relevant in cultural contexts where authority-oriented learning traditions influence how students perceive and interact with sources of knowledge (Ning, Rind & Asad 2020; Perry 1970; Schommer-Aikins et al. 2004).

Recent scholarship highlights the dual challenge of integrating GenAI effectively while avoiding the erosion of analytical and evaluative skills (Kasneci et al. 2023; Perrault et al. 2023). Studies have shown that without explicit pedagogical scaffolding, AI adoption can reinforce epistemic passivity and confirmation bias (Chen et al. 2021; Zawacki-Richter et al. 2019). Conversely, when students are trained to interrogate GenAI outputs, compare them with credible sources, and reflect on their reasoning processes, AI can serve as a catalyst for deeper learning (Tang et al. 2022).

Although existing research has explored GenAI adoption and epistemic beliefs in Western higher education, limited empirical work examines these dynamics in the Gulf region. In contexts such as Oman, where education systems have historically emphasised authority-oriented and rote-based learning (Al Hina 2023; Al Balushi et al. 2020), students may approach AI-generated information differently than their Western counterparts. This makes the region a critical setting for understanding how cultural norms, academic traditions, and technological access shape epistemic engagement with GenAI.

This study investigates how undergraduate students with varying epistemic beliefs perceive and engage with ChatGPT as a knowledge source. Drawing on Hofer and Pintrich's (1997) four-dimensional model of epistemic beliefs, i.e., attainability, certainty, source, and justification, this research explores how these orientations influence students' trust in and critical evaluation of AI-generated responses. The focus is on capturing the diversity of engagement patterns, from unquestioning reliance to systematic critical evaluation, and examining the socio-cultural and educational factors that shape these patterns. This study aims to identify distinct patterns of student engagement with ChatGPT in relation to their epistemic beliefs, and to explore how cultural norms, educational experiences, and academic pressures influence trust and verification of GenAI outputs.

By exploring these dynamics, this study contributes to the emerging field of AI literacy in education, offering insights for designing instructional strategies that promote epistemic awareness and critical engagement in AI-mediated learning environments. In doing so, it addresses a pressing need for pedagogies that prepare students to navigate a rapidly evolving knowledge ecosystem where AI is both an opportunity and a challenge for higher education.

## LITERATURE REVIEW

### EPISTEMIC BELIEFS

Epistemic beliefs, individual conceptions about the nature of knowledge and the process of knowing, have been conceptualised from two main perspectives: developmental and individual belief. From a developmental standpoint, Perry (1970) described progression from dualist thinking (knowledge as fixed and certain) to multiplist and eventually committed-relativist perspectives, where multiple viewpoints are acknowledged but evaluated for merit. Building on this, Kuhn (1991) proposed three epistemic levels, i.e., absolutist, multiplist, and evaluativist, each reflecting increasing sophistication in reasoning.

The individual-belief perspective, advanced by Schommer (1990), emphasised that beliefs about knowledge develop along multiple dimensions, such as stability, structure, and source, rather than in a single linear progression. Hofer and Pintrich (1997) refined this model, identifying four core dimensions: certainty, simplicity, source, and justification of knowledge. Later, Hofer (2000) merged certainty and simplicity, adding attainability as a fourth dimension. In the present study, this model was adopted to conceptualise epistemic beliefs, as it provides a comprehensive lens for understanding how individuals approach knowledge acquisition and change within the specific context of engaging with ChatGPT. This theoretical grounding informed the design of a semi-structured interview protocol that enabled a detailed exploration of participants' developmental trajectories in relation to their interactions with GenAI.

### GENERATIVE AI AS A KNOWLEDGE SOURCE

GenAl has emerged as a transformative force in how people access, process, and apply information, raising new questions about its role as a source of knowledge. Tools such as ChatGPT produce human-like responses by

drawing on vast datasets, making them increasingly popular among students for tasks ranging from brainstorming ideas to completing assignments. While these systems can offer quick, coherent, and contextually relevant outputs, their probabilistic nature means that the accuracy and depth of the information cannot always be guaranteed (Kasneci et al. 2023; Zhang & Zhu, 2024). This presents both opportunities and challenges for education. On one hand, GenAI can democratize access to information, enhance productivity, and stimulate inquiry. On the other, it may reinforce superficial engagement if students treat AI-generated content as authoritative without verification (Rind, 2026).

Scholars have noted that GenAI occupies a complex position in the epistemic landscape. It does not generate new knowledge in the scientific sense but rather synthesises and reformulates existing information in ways that appear original to the user (Floridi & Chiriatti 2020). This has significant implications for epistemic trust, as users must learn to evaluate AI outputs critically, understanding that the quality of responses is constrained by training data, algorithmic biases, and inherent limitations in reasoning. Zawacki-Richter et al. (2019) argue that without explicit guidance, students may develop an uncritical dependency on AI tools, mistaking fluency of expression for accuracy of content. This is particularly concerning in higher education, where independent judgment and evidence-based reasoning are core learning objectives.

The literature increasingly emphasises the need to situate AI use within a framework of information literacy and critical thinking. Perrault et al. (2023) highlight that the perceived authority of GenAI can influence students' epistemic beliefs, especially for those who already hold views that knowledge is certain and originates from authoritative sources. This can lead to confirmation bias, where users accept outputs that align with their assumptions while ignoring contradictory evidence. In contrast, students with more sophisticated epistemic beliefs tend to use AI tools as one of several sources, engaging in verification and triangulation before forming conclusions.

Another dimension of the discussion focuses on the potential for GenAI to shape not only what students learn but also how they learn. Luckin et al. (2022) caution that if AI becomes a default source of answers, it may inadvertently reduce opportunities for learners to engage in productive struggle, which is essential for deep cognitive processing. At the same time, when integrated intentionally, AI can serve as a catalyst for inquiry, prompting students to question, explore alternative perspectives, and refine their understanding. Studies such as those by Tang et al. (2022) show that when students are explicitly taught to interrogate AI-generated information, they are more likely to adopt active reasoning strategies, leading to improved knowledge construction and retention.

In the context of this study, ChatGPT represents a unique case of GenAI functioning as an immediate, conversational source of information that mimics human expertise. Its accessibility and adaptability make it an appealing tool for university students across disciplines. However, its role as a knowledge source depends heavily on the user's epistemic orientation. Understanding these orientations and how they shape students' interaction with AI is essential for designing pedagogical strategies that cultivate responsible, informed, and reflective engagement with technology.

## PEDAGOGICAL STRATEGIES FOR CRITICAL AI ENGAGEMENT

Critical thinking is widely recognised in educational research and policy as a core competency for success in the 21st century. It is generally understood as a reflective, purposeful, and reasoned process of deciding what to believe or do, involving the ability to conceptualise, apply, analyse, synthesise, and evaluate information derived from observation, experience, and communication (Paul & Elder 2006; Facione 2013). While definitions vary, scholars agree that it is central to enabling individuals to identify assumptions, test the validity of ideas, consider multiple perspectives, and make informed decisions based on evidence (Brookfield 2012; Halpern 1998). Across different national contexts, the integration of critical thinking into curricula reflects a global trend in preparing students to operate effectively in complex and rapidly changing knowledge economies (P21 2006; The Guardian 2023). Economies that prioritise these skills are often more innovative and competitive, with critical thinking underpinning the intellectual capital necessary for growth and adaptability (Corrado et al. 2009).

The rise of GenAI has added a new dimension to the imperative for critical thinking in education. Tools such as ChatGPT are capable of generating persuasive, human-like responses to a wide range of queries, but their reliability is dependent on training data, probabilistic modelling, and algorithms that can reproduce biases or factual errors (Kasneci et al. 2023; Floridi & Chiriatti 2020). In this context, critical thinking becomes essential for evaluating AI outputs, distinguishing between accurate and misleading information, and understanding the limitations of algorithmic systems (Perrault et al. 2023). Without deliberate instructional support, students may conflate fluency of expression with credibility, especially when AI responses align with their pre-existing beliefs. Research shows that integrating explicit questioning of AI-generated content into coursework encourages students to adopt evidence-based reasoning and resist uncritical acceptance (Tang et al. 2022; Zawacki-Richter et al. 2019).

Pedagogical strategies to foster critical thinking in the age of GenAI need to address both cognitive skills and epistemic dispositions. Socratic questioning encourages learners to clarify their reasoning, uncover assumptions, and explore alternative perspectives (Paul & Elder 2006). Philosophical inquiry, as proposed by Lipman (2003), engages students in structured dialogue that sharpens their analytical and reflective capacities. Meta-analyses by Abrami et al. (2008) show that explicit instruction in critical thinking yields stronger outcomes than implicit methods, underscoring the importance of structured interventions. Collaborative learning strategies, such as structured debates, peer critique, and group problem-solving, help learners test arguments in social contexts, refining both reasoning and communication skills (Johnson & Johnson 2009).

Embedding critical thinking within subject-specific instruction is particularly effective, as it allows students to apply reasoning to authentic disciplinary problems (Beyer 2008). In STEM fields, inquiry-based and problem-based learning approaches can be aligned with causal reasoning models, moving students from single-variable to multivariable thinking that mirrors the complexity of real-world problems (Rind 2022; Kuhn 2016; Zimmerman 2007). This shift enables learners to analyse interactions between multiple factors, improving their ability to construct and test evidence-based explanations.

Argumentation is another vital component, as it develops the ability to construct coherent claims, evaluate counterarguments, and integrate rebuttals in ways that demonstrate both logical consistency and evidentiary support (Erduran & Jiménez-Aleixandre 2008; Sadler & Zeidler 2005). High-quality argumentation requires students to align claims with valid evidence and strong reasoning, which directly counters the tendency to accept information at face value, an important skill when engaging with AI-generated responses. Claim-evidence coordination, identified by Kuhn (2018) as a higher-order thinking skill, enables learners to separate the content of a claim from the strength of the evidence supporting it, a critical safeguard against misinformation and unsupported assertions.

In the age of GenAI, these pedagogical strategies, Socratic questioning, philosophical inquiry, explicit critical thinking instruction, collaborative argumentation, causal and proportional reasoning, and claim-evidence coordination, must be intentionally integrated into teaching and learning. By embedding these approaches in both digital literacy and disciplinary instruction, educators can equip students with the cognitive tools and epistemic awareness needed to engage critically with AI-generated knowledge, fostering informed judgment and deeper learning in increasingly complex information environments.

## METHODOLOGY

The study adopted a qualitative research methodology to explore in depth how participants' epistemic development influenced their perceptions and use of ChatGPT. This approach was guided by our philosophical stance of constructivism and our epistemic stance of interpretivism. We view knowledge as socially constructed, shaped by individuals' experiences and interactions, and believe that the most effective way to understand participants' realities is to provide them with the opportunity to express their perspectives in their own words (Creswell & Poth 2018; Merriam & Tisdell 2016).

Our investigation was framed by Hofer and Pintrich's (1997) four-dimensional epistemic belief model, which includes Attainability of Knowledge, Certainty of Knowledge, Source of Knowledge, and Justification of Knowledge. To explore these dimensions in the context of ChatGPT use, we developed a semi-structured interview guide adapted from Hofer's (2000) Science-Focused Epistemological Belief Questionnaire. While the original questionnaire was designed to address science-related contexts, we reoriented the items to focus on participants' engagement with ChatGPT. In doing so, we retained most of the characteristics of Hofer's instrument, such as the conceptual clarity of each dimension and the probing nature of the questions, but allowed for flexibility in participant responses. This ensured that while our inquiry remained anchored in a robust theoretical framework, it also gave participants the space to share their experiences, reasoning processes, and reflections freely. The aim was to privilege their voices in the construction of knowledge about this emerging phenomenon (Kvale & Brinkmann 2015).

Thirteen participants from different academic disciplines were purposively selected from a university located in the Northern Al Batinah region of Oman (see Table 1 for details). The sample was chosen to ensure diversity in epistemic orientations, academic backgrounds, and levels of familiarity with ChatGPT, in line with the qualitative research principle of selecting information-rich cases (Patton 2015). Each participant was interviewed twice. The first interviews ranged between 30 and 120 minutes, allowing for in-depth exploration of their epistemic beliefs and experiences with ChatGPT. The second interviews, which ranged from 20 to 40 minutes, were conducted after all first-round interviews had been completed. These follow-up interviews were designed to triangulate and cross-reference ideas that emerged in the initial conversations, ensuring greater depth and consistency in the data. Most interviews were conducted in English; however, some participants naturally switched into Arabic during the discussion. These segments were translated and

validated by a professional Arabic language expert to ensure accuracy and preserve the meaning of participants' expressions.

Research ethics were an integral part of this study. Ethical approval was obtained from the university's institutional review board prior to data collection. All participants were provided with detailed information about the study's aims, procedures, and potential uses of the findings. Written informed consent was obtained before the interviews, ensuring that participation was entirely voluntary and that participants retained the right to withdraw at any stage without consequence (Israel & Hay 2006). Anonymity and confidentiality were strictly maintained. Participants were assigned pseudonyms in transcripts, notes, and all subsequent reporting. Any identifying information was removed or altered to prevent recognition, and all data were securely stored in password-protected files accessible only to the research team.

Our commitment to a qualitative approach was also informed by the importance of researcher reflexivity. We recognise that our own backgrounds, experiences, and beliefs shape the way we interpret participants' accounts (Rind 2021; Berger 2015). To address this, we engaged in ongoing reflexive practice throughout the research process, critically examining our positionality and potential biases. This included maintaining reflective journals during data collection and analysis, discussing interpretations with peers, and revisiting the data to ensure that findings were grounded in participants' own expressions rather than our assumptions.

Data were analysed using thematic analysis, following Braun and Clarke's (2006) six-step framework. First, during familiarisation, transcripts were read multiple times and annotated with initial reflections. Second, coding was conducted inductively, focusing on patterns related to students' epistemic beliefs, trust in AI, and critical engagement strategies. Third, in theme development, codes were grouped into themes that reflected variations in students' cognitive engagement with ChatGPT. Fourth, the themes were reviewed to ensure internal consistency and clear distinctions between them. Fifth, each theme was defined and contextualised with participant quotes to capture the essence of their perspectives. Finally, the writing stage involved synthesising the findings into four primary themes: Naïve Believers, Over-Reliant Users, Strategic Skeptics, and Critical Evaluators (Table 2). This systematic approach ensured that the themes were firmly grounded in the data and that participants' voices were central to the interpretation.

This methodological design reflects our belief that the meaning participants attribute to their experiences is best understood through an interpretive lens, where the researchers' role is to listen attentively, probe thoughtfully, and represent participants' perspectives with integrity. In doing so, we aimed to generate a rich, contextually grounded account of how epistemic development shapes students' perceptions and uses of ChatGPT.

TABLE 1. Details of research participants

| Pseudonym | Gender | Discipline & Year | Epistemic Category in qualitative analysis |
|---|---|---|---|
| Seema | Female | English Language and Literature, 3rd Year | Naïve Believer |
| Hina | Female | Computer Science, 3rd Year | Naïve Believer |
| Asma | Female | English Language and Literature, 2nd year | Naïve Believer |
| Zara | Female | English Language and Literature, 2nd year | Naïve Believer |
| Iman | Male | English Language and Literature, 2nd year | Naïve Believer |
| Fareen | Female | English Language and Literature, 2nd Year | Over-Reliant User |
| Murtaza | Male | English Language and Literature, 3rd Year | Over-Reliant User |
| Eassa | Male | Computer Science, 3rd Year | Strategic Skeptic |
| Jamel | Male | Education, Final Year (and part-time teacher) | Strategic Skeptic |
| Imran | Male | English Language and Literature, Final Year | Strategic Skeptic |
| Mahmood | Male | Education, 3rd Year | Strategic Skeptic |
| Farah | Female | Business Studies, Final Year | Critical Evaluator |
| Isra | Female | English Language and Literature, Final Year | Critical Evaluator |

## FINDINGS

Thematic analysis revealed a continuum of epistemic orientations toward ChatGPT, ranging from unquestioning trust to systematic critical evaluation. Four distinct categories emerged: Naïve Believers, Over-Reliant Users, Strategic Skeptics, and Critical Evaluators. Figure 1 illustrates this continuum with key descriptors for each category. Table 2 synthesizes their epistemic beliefs, interaction patterns with ChatGPT, typical behaviors, and risks for learning.

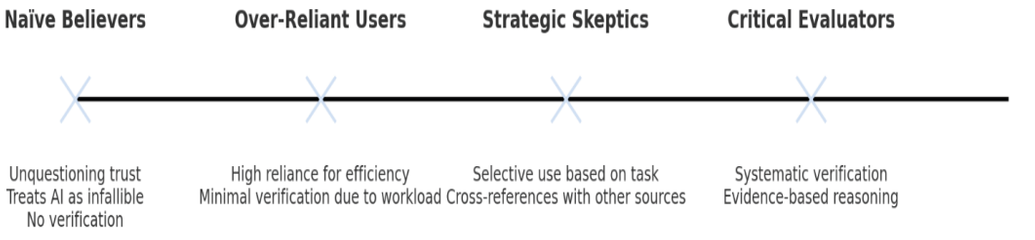


FIGURE 1. Continuum of Student Engagement with ChatGPT Based on Epistemic Beliefs

TABLE 2. Conceptual summary of four categories of individuals identified in findings

| Category | Core Epistemic Beliefs | Engagement with ChatGPT | Typical Behaviors and Attitudes | Learning Risks / Limitations |
|---|---|---|---|---|
| Naïve Believers | Knowledge is fixed, certain, and externally validated; truth resides in authority (Hofer & Pintrich, 1997; Perry, 1970). | Treat ChatGPT as an infallible authority; rarely question or verify outputs. | Blind trust in AI responses; equate ChatGPT with expert or teacher knowledge; minimal critical inquiry. | Reinforces epistemic dependency, rote learning, and misinformation acceptance. |
| Over-Reliant Users | Knowledge is useful but taken-for-granted; accuracy assumed if output appears coherent. | Use ChatGPT as an academic shortcut under time or workload pressure. | Pragmatic dependence; prioritize efficiency over accuracy; limited verification or reasoning. | Surface learning and diminished critical reflection; potential inaccuracies in academic work. |
| Strategic Skeptics | Knowledge is context-dependent and provisional; truth varies by task and evidence. | Use ChatGPT strategically for certain tasks (e.g., coding, conceptual clarification) but cross-check key ideas. | Balance convenience with caution; apply disciplinary judgment; validate AI outputs using alternative sources. | Occasional overconfidence in AI reliability for non-critical tasks. |
| Critical Evaluators | Knowledge is constructed, evolving, and evidence-based; credibility established through justification. | Use ChatGPT as a thinking partner, not a final authority; systematically verify and triangulate information. | Question assumptions, cross-reference sources, and integrate AI insights within broader evidence frameworks. | Few risks; may underuse AI due to skepticism. |

## NAÏVE BELIEVERS

This theme captures students who displayed a strong and unquestioning trust in ChatGPT, perceiving it as an authoritative, infallible source of knowledge. These students exhibited minimal critical engagement and often equated AI-generated content with expert or teacher-like authority. This group includes Seema, Asma, Zara and Iman (students of English Language and Literature), and Hina (student of Computer Science). Their shared orientation reflects deeply rooted authority-oriented epistemic beliefs, often shaped by cultural, familial, and educational experiences.

Participants viewed knowledge as fixed, certain, and derived from authoritative sources, consistent with Hofer and Pintrich's (1997) framework of naïve epistemic beliefs. Seema remarked, "If ChatGPT says something, I believe it because it's based on facts. I don't think it would make mistakes." Similarly, Asma stated, "I think ChatGPT has all the answers. If I ask something and it provides a response, I don't feel the need to check it again. It's like an encyclopedia". Such perceptions align with Barzilai and Zohar's (2012) argument that students with underdeveloped epistemic cognition tend to rely heavily on authority figures, including AI.

This unwavering trust extended to assumptions of accuracy and comprehensiveness. Zara said, "I trust ChatGPT because it's created by experts. They must have programmed it to always be correct," while Hina described ChatGPT as a surrogate teacher: "ChatGPT is like a teacher to me. It knows everything and provides the right answers all the time." Likewise, Iman noted, "I feel like ChatGPT is just like a teacher. Why would it give wrong answers? It's better than searching random websites."

Participants rarely questioned or verified ChatGPT's outputs. Seema admitted, "I never think about checking if ChatGPT is correct. I just use the information as it is," and Hina explained, "I don't compare ChatGPT's answers with other sources because I assume it's already accurate." These behaviors reflect findings by Chen et al. (2021) and Lee et al. (2023), who report that students with naïve beliefs often struggle to identify errors or biases in AI-generated responses.

The participants' trust was also rooted in their social and educational environments. Zara described her schooling experience: "We were taught to respect the textbook. Whatever was written there was the truth. I think that's why I don't question ChatGPT either." This echoes Perry's (1970) notion of dualist thinking, where knowledge is accepted in black-and-white terms. Hina noted, "In our family, we don't question what experts or elders say. It's about respect and trust. I think that's why I trust ChatGPT." Similarly, Asma shared, "In our home, we were always taught to listen to elders and not question them. Maybe that's why I trust ChatGPT… it feels like listening to someone who knows better."

The reliance on ChatGPT often led to academic setbacks and diminished learning engagement. Seema recounted, "Once, I copied an answer from ChatGPT for my assignment,… and it turned out to be wrong…. I didn't realize it until my teacher pointed it out." Hina confessed, "Sometimes, I feel like I'm not learning much because I just follow what ChatGPT says instead of figuring things out on my own." Likewise, Iman remarked, "Maybe I should check the answers, but honestly, I never thought of it." These anecdotes reinforce concerns raised by Barzilai and Weinstock (2015) and Hofer (2000), who argue that uncritical reliance on authoritative sources, like AI tools, can hinder the development of analytical reasoning and deep learning.

To support students with such authority-driven beliefs, there is a need for structured pedagogical interventions that promote critical inquiry and digital literacy. Seema suggested, "It would help if teachers taught us how to check ChatGPT's answers and use it properly," while Hina proposed, "If there were sessions on how to use ChatGPT responsibly and how to verify its answers… I think it would help students like me a lot." These proposals align with the recommendations of Kuhn and Weinstock (2002) and Chinn et al. (2011), who advocate for instructional practices that develop epistemic awareness and foster evaluative thinking in digital environments.

## OVER-RELIANT USERS

Following the authority-driven trust displayed by the previous group, this theme explores a distinct yet related epistemic orientation, students who demonstrate instrumental dependence on ChatGPT. While these Over-Reliant Users do not necessarily view ChatGPT as infallible or authoritative in the same way as Naïve Believers, they nevertheless depend heavily on it, primarily due to academic pressure, convenience, and time constraints. The participants in this group include Fareen and Murtaza from English Language and Literature program.

Unlike those in the previous theme, Over-Reliant Users are less concerned with the epistemic certainty of ChatGPT's outputs and more focused on its functionality as a shortcut or academic support tool. Fareen shared, "ChatGPT always gives me the answers I need. I don't feel the need to check anywhere else because it explains things so well." Her response reflects a utilitarian logic rather than reverence, aligning with

Chen et al.'s (2021) findings on how digital tools are often used as coping mechanisms in high-pressure learning environments.

Murtaza echoed this perspective: "It's convenient and fast, and I assume it's accurate because it's an advanced AI. I don't have time to cross-check everything." His statement reveals an implicit trust in the technological sophistication of ChatGPT, but more importantly, highlights how academic overload drives the bypassing of critical evaluation, what Barzilai and Weinstock (2015) call strategic surface learning.

Over-Reliant Users are also shaped by educational conditioning and cultural expectations, though in a slightly more pragmatic sense compared to the authority-oriented group. Fareen reflected, "In school, we were taught to memorize and repeat what was in the textbook. I think that's why I just accept what ChatGPT says without questioning it." This ties into Perry's (1970) developmental model, where such rote-based learning fosters passivity and discourages cognitive autonomy. Similarly, Murtaza explained, "In my family, we respect expertise a lot. If someone knows more, you listen to them. I think that's why I see ChatGPT as an expert." While this echoes authority-oriented beliefs, his framing is more situational and less absolute, suggesting that the dependence stems as much from habit and urgency as from epistemic worldview.

Both participants emphasized time-saving and task completion as key motivators for their reliance. Fareen admitted, "When I'm under pressure, I just use ChatGPT because it's quick and gives me exactly what I need." Likewise, Murtaza noted, "I have so many assignments, and ChatGPT helps me finish them faster. I don't think I'd manage without it." These sentiments resonate with findings by Lee et al. (2023, who observed that time pressure, when coupled with limited digital literacy, often leads to uncritical use of AI tools.

The risks of this instrumental dependence include both academic inaccuracies and erosion of deeper learning skills. Fareen recounted, "There was a time ChatGPT gave me a wrong answer in an assignment, and I didn't realize until my teacher pointed it out." Murtaza expressed concern about his own intellectual engagement: "Sometimes I feel like I'm not learning as much because I just use ChatGPT for everything." These experiences align with Hofer's (2000) caution that over-dependence on external sources inhibits the development of reflective and critical thinking.

To support students like Fareen and Murtaza, educational strategies must move beyond technical training and instead cultivate metacognitive awareness and task-specific digital literacy. As Fareen proposed, "It would help if teachers showed us how to check ChatGPT's answers and use it properly." Similarly, Murtaza suggested, "Workshops on how to use AI tools responsibly could make a big difference. We need to understand its limits." These recommendations echo the work of Chinn et al. (2011), Kihn and Weinstock (2002) and Rind and Ning (2020), who advocate for interventions that promote evaluative thinking, even among pragmatically oriented learners.

## STRATEGIC SKEPTICS

Building upon the previous theme of instrumental dependence, this theme reflects a more evolved engagement with ChatGPT, one that is situationally adaptive, strategically critical, and pragmatically reflexive. While these students also recognize the usefulness of ChatGPT, they differ markedly from over-reliant users in their awareness of its limitations, task-specific judgment, and integration of AI into broader academic and disciplinary contexts. This group includes Eassa (third-year Computer Science), Jamel (final-year Education and part-time school teacher), Imran (final-year English Language and Literature), and Mahmood (third-year Education).

These students displayed a sophisticated understanding of knowledge as contextual and contingent, aligning with Kuhn and Weinstock's (2002) and Hofer and Pintrich's (1997) descriptions of evaluativist epistemic beliefs. Rather than treating ChatGPT as an all-knowing authority or a mere shortcut, they positioned it as a flexible tool, useful in certain domains but insufficient for others. Eassa articulated this distinction clearly: "ChatGPT is great for coding help, like debugging or explaining a concept quickly, but I know it's not perfect, especially with complex algorithms." His discipline-specific awareness and tendency to validate with trusted external sources (e.g., Stack Overflow) align with findings by Chinn et al. (2011) and Lee et al. (2023), which emphasize the role of digital literacy and disciplinary training in moderating AI reliance.

Imran, similarly, emphasized contextual decision-making based on academic task: "ChatGPT is useful when I need an overview of a topic, but for in-depth analysis, I prefer going to primary sources." His response reflects the practice of epistemic calibration (Barzilai & Weinstock 2015), where AI use is modulated based on complexity and academic expectations.

Jamel, drawing from his dual identity as a student and teacher, noted: "I use it to get ideas or structure my lessons, but I always modify and add my own input. It (ChatGPT) can't know my students the way I do." His judgment reflects what Schraw and Olafson (2008) describe as pedagogical epistemic sophistication, an ability to blend professional intuition with technological assistance. Mahmood, too, exemplified this pragmatism through his comparative use across disciplines: "For lesson planning,

it's great, but for policy-related questions, I'd rather rely on academic journals and policy archives." His example illustrates how task specificity, academic conventions, and topic complexity drive the choice of whether and how to engage with AI content.

These users not only adapted their strategies based on task, but also demonstrated an intentional blending of AI with human judgment and conventional sources. Imran summarized his workflow: "I use ChatGPT to save time, but I don't let it replace my own analysis or deeper research." This echoes Barzilai and Zohar's (2012) call for epistemic multitasking in digital environments, where learners actively combine sources, perspectives, and tools.

Despite recognizing ChatGPT's utility, all participants were acutely aware of its limitations, particularly its superficiality, lack of domain expertise, or inability to understand cultural norms. Mahmood explained, "ChatGPT can't understand the dynamics of certain topics, especially cultural or ethical issues. That's where I know I need to rely on my judgment." This aligns with Hofer's (2000) assertion that mature epistemic thinking involves identifying boundaries of knowledge systems.

Social and educational environments played a formative role in shaping these context-sensitive approaches. Eassa noted the influence of his instructors: "Our professors always stress testing and validating solutions. I think that's why I naturally question ChatGPT's answers." Similarly, Mahmood pointed to his upbringing: "In our family, we're taught to respect diverse opinions and think carefully before making decisions. That might be one of the reasons I mostly cross-check ChatGPT's outputs."

Overall, this theme highlights a crucial developmental leap in students' AI engagement, from passive acceptance or utilitarian use toward a critically balanced, reflexive, and adaptable application. These learners exemplify how epistemic maturity and digital literacy can coalesce to support responsible AI use in higher education. Their approaches mirror the recommendations of Greene et al. (2008) and Chen et al. (2021), who emphasize the importance of fostering discipline-specific reasoning, contextual awareness, and ethical discernment in students' interaction with intelligent technologies.

## CRITICAL EVALUATORS

The final theme in this continuum represents the most epistemically sophisticated users, students who approach ChatGPT with a high degree of critical awareness, academic reasoning, and methodological discipline. Unlike Strategic Skeptics who adapt their AI use according to task complexity, the students in this category, including Farah (final-year Business Studies) and Isra (final-year English Language and Literature), demonstrated an enduring and systematic habit of validation, treating ChatGPT as a starting point rather than a destination.

These critical evaluators embraced the notion that knowledge is evolving, provisional, and evidence-dependent, aligning with Hofer and Pintrich's (1997) and Kuhn and Weinstock's (2002) models of evaluativist epistemic beliefs. Farah clearly articulated this belief: "I don't think any one source can have all the answers, not even ChatGPT. It's a starting point, but I always verify what it says with reliable references." Her approach reflects Barzilai and Zohar's (2012) characterization of epistemically mature learners who see knowledge as multi-perspectival and grounded in evidence rather than authority or convenience. Similarly, Isra explained, "ChatGPT is helpful for brainstorming, but it's not always accurate. I see it as a tool to build on, not the final word on anything." This conceptualization of ChatGPT as a provisional partner rather than an authoritative voice aligns with Chinn et al.'s (2011) findings that students with evaluative epistemologies actively triangulate information across sources.

Critical evaluators also distinguished themselves through their academic rigor in cross-referencing. Farah shared, "Whenever I use ChatGPT, I always check the information in academic articles or credible websites. It's a habit I developed during my business research classes." This echoes the work of Chen et al. (2021), who argue that digital literacy training fosters critical verification practices. Isra, drawing from her training in literary studies, added, "Sometimes ChatGPT gives outdated or generalized information. I know it's not an expert, so I always compare its answers with recent journal articles." Her academic skepticism mirrors Lee et al.'s (2023) conclusion that students trained in disciplinary research methods are better equipped to identify inaccuracies in AI outputs.

The development of these critical habits was strongly shaped by both educational practices and familial environments. Farah credited her university coursework: "My professors always emphasized critical thinking and evidence-based arguments. That's why I don't just accept ChatGPT's answers as they are." This supports Kuhn's (1991) argument that inquiry-based learning environments are instrumental in cultivating evaluative epistemic cognition. Isra highlighted the influence of family discourse: "In my family, we're always encouraged to question and discuss things. I think that's why I'm naturally skeptical of any single source, including ChatGPT." This aligns with Greene et al.'s (2008) assertion that dialogic and open communication within families contributes significantly to epistemic maturity.

While they appreciated the utility of ChatGPT for ideation or surface-level synthesis, critical evaluators were consistently mindful of its limitations in context, and domain-specific accuracy. Farah reflected, "It's good for quick summaries or generating ideas, but I know it's not perfect. Sometimes it misses details or makes assumptions that aren't valid." Isra pointed out its limitations in her field: "I've noticed it sometimes oversimplifies complex topics, especially in literature. That's why I use it carefully and always double-check." These insights reflect Hofer's (2000) argument that recognition of knowledge limitations is a hallmark of advanced epistemic cognition.

Ultimately, critical evaluators demonstrated a meta-awareness of their own learning process and the role AI could play within it. Their practices reveal how AI tools like ChatGPT can become valuable companions in academic inquiry, but only when mediated by evidence, self-regulation, and disciplinary standards. Their perspectives reinforce the call by Chen et al. (2021) and Barzilai and Weinstock (2015) for higher education to prioritize critical digital literacy, empowering students not merely to use AI tools, but to challenge, interrogate, and contextualize them in the service of knowledge-building.

## DISCUSSION

This study explored how undergraduate students with differing epistemic beliefs engage with ChatGPT, revealing a continuum of orientations ranging from unquestioning trust to critical and strategic use. These findings align with and extend existing theoretical frameworks on epistemic cognition (Hofer & Pintrich 1997; Kuhn & Weinstock 2002) and contribute to emerging scholarship on AI literacy in educational settings (Zawacki-Richter et al. 2019; Perrault et al. 2023).

Students categorized as naïve believers exhibited dualist epistemic beliefs, seeing knowledge as fixed, certain, and residing in external authorities. For them, ChatGPT was not a tool to be interrogated but a surrogate for expert knowledge. This orientation is consistent with Hofer and Pintrich's (1997) model and Perry's (1970) early stages of epistemic development. As Barzilai and Zohar (2012) explain, such learners often equate source credibility with truth, foregoing the need for validation. Lee et al. (2023) caution that such uncritical reliance on AI tools risks undermining digital literacy, critical reasoning, and academic integrity.

In contrast, critical evaluators demonstrated the most epistemically mature behaviors. These students systematically cross-referenced ChatGPT's outputs, viewed knowledge as contextual and evolving, and emphasized evidence-based reasoning, an approach aligned with Kuhn and Weinstock's (2002) evaluativist stance. Their actions illustrate the impact of inquiry-based education (Chinn et al. 2011) and domain-specific epistemic training (Greene et al. 2008), which foster reflective engagement and critical source evaluation. Isra's insistence on verifying AI responses against journal articles, for instance, highlights the role of disciplinary norms in shaping responsible AI use (Tang et al. 2022).

Skeptical pragmatists occupied the middle of this continuum. They used ChatGPT selectively, adjusting their reliance based on the task at hand, mirroring Barzilai and Weinstock's (2015) concept of epistemic calibration. Jamel's and Mahmood's reflections suggest that teaching experience and task complexity foster nuanced decision-making about when to trust AI and when to defer to human judgment or traditional academic sources. Their engagement also reflects the growing relevance of AI-informed but human-centered pedagogies (Luckin et al. 2024).

Over-reliant users, meanwhile, reflected a utilitarian but cognitively passive stance. Although they did not attribute absolute authority to ChatGPT, they leaned on it for efficiency, often without questioning its accuracy, especially under time pressure. This pattern aligns with Schommer's (1990) view that students with simplistic epistemic beliefs treat knowledge as certain and unproblematic, and are more susceptible to accepting information at face value. Fareen's continued reliance on ChatGPT despite known errors illustrates the risk of efficiency-driven dependence, as warned by Perrault et al. (2023) and Zawacki-Richter et al. (2019), who note that without critical scaffolding, AI tools can unintentionally reinforce epistemic passivity.

Across themes, students' epistemic beliefs were strongly shaped by social and educational contexts. Those from rote-learning environments and culturally hierarchical settings, as seen in Seema's and Zara's experiences, tended to accept AI outputs uncritically. This supports Schommer-Aikins et al.'s (2004) claim that family norms and school culture reinforce epistemic orientations. Conversely, students exposed to inquiry-based learning and dialogic family settings, like Farah and Imran, were more inclined to question, cross-verify, and reflect, echoing Greene et al. (2008) and Hofer (2000).

Furthermore, academic pressure and systemic workload demands were shown to influence students' epistemic engagement with AI. Murtaza's and Fareen's cases exemplify how contextual constraints, not just cognitive beliefs, can push students toward uncritical usage. Barzilai and Weinstock (2015) argue that when efficiency becomes the dominant goal, epistemic effort declines. This underscores the need to address structural pressures, not just individual cognition, when designing AI-integrated pedagogy.

### EPISTEMIC PEDAGOGIES FOR AI-ERA CLASSROOMS

The findings call for a pedagogical shift, from content transmission to epistemic empowerment. Engaging effectively with GenAI tools like ChatGPT require more than technical know-how; it demands a restructuring of how students think about knowledge, especially in uncertain, complex, and fast-evolving contexts. A key recommendation is to cultivate multivariable thinking, as proposed by Kuhn (2016), which surpasses traditional univariable reasoning embedded in most curricula. Real-world and AI-generated knowledge often involves multiple interacting causes and probabilistic logic. Students must therefore be trained to recognize and evaluate multiple causal variables, assess the credibility of evidence, and compare competing claims, a capacity not automatically developed in traditional instruction (Rind, 2022; Kuhn et al. 2017). This transformation can be facilitated through three interconnected strategies:

1. Argumentation-Based Learning: Teaching students to construct and evaluate arguments encourages deeper engagement with content and promotes active comparison of evidence and alternatives (Kuhn et al. 2017). When students are asked to compare AI-generated claims with peer-reviewed research, they move from passive consumption to active reasoning.
2. Claim-Evidence Coordination: Explicit instruction on how to connect claims with evidence and assess coherence improves scientific and critical reasoning (Kuhn & Crowell, 2011). ChatGPT's plausibility often masks its limitations; students must learn to interrogate not only the outputs but the reasoning structures behind them.
3. Metacognitive Scaffolding: Tools like guided questioning (Rind, 2022; Arvidsson & Kuhn 2021) and self-explanation prompts help students monitor their cognitive processes. Asking students, "What makes you trust this AI response?" or "What assumptions underlie this claim?" fosters metacognitive awareness and epistemic humility, both essential when working with AI.

These instructional strategies align with empirical research showing their effectiveness in promoting conceptual understanding and reflective thinking (Rind, 2022; Blank, 2000; Tang et al. 2022). When embedded in curriculum design, they help students transition from viewing AI as an answer machine to a thinking partner, a perspective that encourages agency, skepticism, and adaptive reasoning.

### PREPARING STUDENTS FOR AI-MEDIATED FUTURES

Ultimately, the study underscores that the issue is not whether students use AI tools like ChatGPT, but how they engage with them epistemically. Fostering epistemic sophistication must become a central goal of 21st-century education. This involves preparing students to navigate a world where AI-generated knowledge is abundant but not always accurate, subtle, or ethically sound (Rind, 2026). By integrating argumentation, multivariable reasoning, and metacognitive scaffolding into instructional design, and by creating learning environments that value questioning over rote reproduction, educators can equip students to engage with AI critically, responsibly, and reflectively. Doing so will not only enhance academic outcomes but also empower students to become knowledgeable citizens in an AI-mediated society.

## CONCLUSION

This study investigated how undergraduate students in Oman engage with ChatGPT as a knowledge source, focusing on the role of epistemic beliefs in shaping patterns of trust, verification, and use. The analysis identified a continuum of engagement that ranged from Naïve Believers, who accepted AI outputs without question, to Critical Evaluators, who systematically verified information against credible sources. Between these two extremes were Over-Reliant Users, who prioritised efficiency over evaluation, and Strategic Skeptics, who adapted their AI use according to task complexity and disciplinary requirements.

The findings demonstrate that epistemic engagement with AI is influenced not only by individual beliefs about knowledge but also by cultural traditions, educational experiences, and academic workload pressures. This reinforces the need for higher education institutions to embed AI literacy as an essential component of academic learning, integrating strategies such as argumentation-based learning, claim–evidence coordination, and guided metacognitive reflection into disciplinary curricula. Faculty development should equip instructors to model these behaviours and design assignments that require students to evaluate and justify AI-generated information. Institutional policies should promote responsible AI use through clear guidelines, aligning learning outcomes with the goal of producing critical and reflective graduates.

## LIMITATIONS

This study was conducted at a single higher education institution in Oman, which may limit the generalisability of the findings to other contexts. The reliance on self-reported data from interviews may also have introduced social desirability bias. Furthermore, the cross-sectional design captures a snapshot of students' epistemic engagement but does not track potential changes over time.

## FUTURE RESEARCH AND POLICY RECOMMENDATIONS

Future research could adopt longitudinal designs to explore how students' epistemic beliefs and AI engagement practices evolve over time, especially as AI literacy initiatives are implemented. Comparative studies across different cultural and educational systems in the Gulf and beyond would deepen understanding of contextual influences. Experimental interventions that integrate structured AI literacy components into coursework could also assess the effectiveness of specific pedagogical strategies. From a policy perspective, national higher education frameworks should recognise AI literacy as a core graduate attribute, ensuring that students are equipped not only with the technical skills to use AI tools but also with the epistemic capabilities to evaluate and integrate AI-generated information responsibly.

By fostering epistemic sophistication and critical digital literacy, higher education in Oman and similar contexts can ensure that AI serves as a catalyst for deeper learning and intellectual growth rather than a source of unquestioned authority or superficial efficiency.

## ACKNOWLEDGEMENT

Sohar University Oman provided financial and strategic support to make this research possible. Moreover, the authors used ChatGPT-5 to assist with enhancing brevity and clarity of expression. The authors retain full responsibility for the originality, accuracy, and authenticity of all ideas, interpretations, and references presented in this work.

## DECLARATION OF COMPETING INTEREST

None.

## REFERENCES

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. 2008. Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research* 78(4): 1102–1134.

Al Balushi, S. M., Ambusaidi, A. K., Al Balushi, K. A., Al Hajri, F. H., & Al Sinani, M. S. 2020. Student centred and teacher centred science classrooms as visualized by science teachers and their supervisors. *Teaching and Teacher Education* 89: 103014.

Al Hinai, S. I. M. 2023. Investigating the washback of English language testing reform on teaching English in Oman (PhD thesis, University of York)

Arvidsson, T. S., & Kuhn, D. 2021. Realizing the full potential of individualizing learning. *Contemporary Educational Psychology* 65: 101960.

Barzilai, S., & Weinstock, M. 2015. Measuring epistemic thinking: A review of methods and constructs. *Educational Psychologist* 50(1): 13–35.

Barzilai, S., & Zohar, A. 2012. Epistemic thinking in action: Evaluating and integrating conflicting evidence. *Metacognition and Learning* 7(1): 5–26.

Berger, R. 2015. Now I see it, now I don't: Researcher's position and reflexivity in qualitative research. *Qualitative Research* 15(2): 219–234.

Beyer, B. K. 2008. What research tells us about teaching thinking skills. *The Social Studies* 99(5): 223–232.

Blank, L. M. 2000. A metacognitive learning cycle: A better warranty for student understanding? *Science Education* 84(4): 486–506.

Braun, V., & Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3(2): 77–101.

Brookfield, S. D. 2012. *Teaching for Critical Thinking: Tools and Techniques to Help Students Question Their Assumptions*. Jossey-Bass.

Chen, X., Wang, L., Zhai, X., & Li, Y. 2022. Exploring the effects of argument map–supported online group debate activities on college students' critical thinking. *Frontiers in Psychology* 13: 856462.

Chinn, C. A., Buckland, L. A., & Samarapungavan, A. 2011. Expanding the dimensions of epistemic cognition: Justification, truth, and source. *Educational Psychologist* 46(3): 141–167.

Corrado, C., Hulten, C., & Sichel, D. 2009. Intangible capital and U.S. economic growth. *Review of Income and Wealth* 55(3): 661–685.

Creswell, J. W., & Poth, C. N. 2018. *Qualitative Inquiry & Research Design: Choosing Among Five Approaches*. 4th edition. SAGE.

Erduran, S., & Jiménez-Aleixandre, M. P., eds. 2008. *Argumentation in Science Education: Perspectives from Classroom-Based Research*. Springer.

Facione, P. A. 2013. Critical thinking: What it is and why it counts (2013 update). Insight Assessment.

Floridi, L., & Chiriatti, M. 2020. GPT-3: Its nature, scope, limits, and consequences. *Minds and Machines* 30(4): 681–694.

Greene, J. A., Azevedo, R., & Torney-Purta, J. 2008. Modeling epistemic and ontological cognition: Philosophical perspectives and methodological directions. *Educational Psychologist* 43(3): 142–160.

Halpern, D. F. 1998. Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist* 53(4): 449–455.

Hofer, B. K. 2000. Dimensionality and disciplinary differences in personal epistemology. *Contemporary Educational Psychology* 25(4): 378–405.

Hofer, B. K., & Pintrich, P. R. 1997. The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research* 67(1): 88–140.

Israel, M., & Hay, I. 2006. *Research Ethics for Social Scientists: Between Ethical Conduct and Regulatory Compliance*. SAGE.

Johnson, D. W., & Johnson, R. T. 2009. An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher* 38(5): 365–379.

Kasneci, E., et al. 2023. ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences* 103: 102274.

Kuhn, D. 1991. *The Skills of Argument*. Cambridge University Press.

Kuhn, D. 2016. What do young science students need to learn about variables? *Science Education* 100(2): 392–403.

Kuhn, D. 2018. A role for reasoning in a dialogic approach to critical thinking. *Topoi* 37(1): 121–128.

Kuhn, D., & Weinstock, M. 2002. What is epistemological thinking and why does it matter? In *Personal Epistemology: The Psychology of Beliefs About Knowledge and Knowing*, edited by B. K. Hofer & P. R. Pintrich, 121–144. Lawrence Erlbaum.

Kuhn, D., & Crowell, A. 2011. Dialogic argumentation as a vehicle for developing young adolescents' thinking. *Psychological Science* 22(4): 545–552.

Kuhn, D., Crowell, A., & Kardash, C. 2017. *Argue with Me: Argument as a Path to Developing Students' Thinking and Writing*. Routledge.

Kvale, S., & Brinkmann, S. 2015. *InterViews: Learning the Craft of Qualitative Research Interviewing*. 3rd edition. SAGE.

Lee, M. K., Hosanagar, K., & Nair, H. S. 2023. *Generative AI—Consumer Awareness, Usage, and Challenges*. SSRN.

Lipman, M. 2003. *Thinking in Education*. 2nd edition. Cambridge University Press.

Luckin, R., Cukurova, M., Kent, C., & Du Boulay, B. 2022. Empowering educators to be AI-ready. *Computers and Education: Artificial Intelligence* 3: 100076.

Luckin, R., Rudolph, J., Grünert, M., & Tan, S. 2024. Exploring the future of learning and the relationship between human intelligence and AI. *Journal of Applied Learning and Teaching* 7(1): 346–363.

Merriam, S. B., & Tisdell, E. J. 2016. *Qualitative Research: A Guide to Design and Implementation*. 4th edition. Jossey-Bass.

Ning, B., Rind, I. A., & Asad, M. M. 2020. Influence of teacher educators on the development of prospective teachers' personal epistemology and tolerance. *Sage Open* 10(1): 2158244020914639.

OpenAI. 2023. GPT-4 technical report. arXiv:2303.08774.

P21—Partnership for 21st Century Skills. 2006. Framework for 21st century learning.

Patton, M. Q. 2015. *Qualitative Research & Evaluation Methods*. 4th edition. SAGE.

Paul, R., & Elder, L. 2006. *The Miniature Guide to Critical Thinking: Concepts and Tools*. 4th edition. Foundation for Critical Thinking.

Perrault, R., Shoham, Y., Brynjolfsson, E., Clark, J., Etchemendy, J., Manyika, J., ... Zhang, Z. 2023. AI Index Report 2023. Stanford HAI.

Perry, W. G., Jr. 1970. *Forms of Intellectual and Ethical Development in the College Years: A Scheme*. Holt, Rinehart & Winston.

Rind, I. A. 2022. Developing prospective science teachers' multivariable thinking capabilities. *Thinking Skills and Creativity* 46: 101168.

Rind, I. A., & Ning, B. 2024. Pre-service teacher education reforms: An attempt to make Pakistan a tolerant society. *The Asia-Pacific Education Researcher* 33(2): 383-394.

Rind, I. A. 2026. Conceptualizing the Impact of AI on Teacher Knowledge and Expertise: A Cognitive Load Perspective. *Education Sciences*, 16(1), 57.

Rind. I. A 2021. Becoming a qualitative ESL researcher: A personal monologue. *Journal of Language and Education*, 7(1 (25)), 219-228.

Rind, I. A., & Ning, B. 2020. Evaluating scientific thinking among Shanghai's students of high and low performing schools. *The Journal of Educational Research* 113(5), 364–373.

Sadler, T. D., & Zeidler, D. L. 2005. The significance of content knowledge for informal reasoning regarding socioscientific issues. *Science Education* 89(1): 71–94.

Schommer, M. 1990. Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology* 82(3): 498–504.

Schommer-Aikins, M. 2004. Explaining the epistemological belief system: Introducing the embedded systemic model and coordinated research approach. *Educational Psychologist* 39(1): 19–29.

Schraw, G., & Olafson, L. 2008. Assessing teachers' epistemological and ontological worldviews. In *Knowing, Knowledge and Beliefs*, edited by M. S. Khine, 25–44. Springer.

Tang, X., Yin, Y., Lin, Q., Hadad, R., & Zhai, X. 2022. The educational value of prompting students to interrogate AI-generated information: Evidence from classroom studies. *Computers & Education Open* 3: 100080.

The Guardian. 2023. Schools must prioritise critical thinking skills to help pupils fight misinformation, says education secretary.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. 2019. Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education* 16(1): 39.

Zhang, J., & Zhang, Z. 2024. AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning* 40: 1871–1885.

Zimmerman, C. 2007. The development of scientific thinking skills in elementary and middle school. *Developmental Review* 27(2): 172–223.