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AI-based Assessment for Learning on Students' Critical Thinking

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Keywords

Artificial intelligence in education (AIED), assessment for learning, critical thinking

Abstract

Critical thinking is essential for state standards and culturally relevant pedagogy (CRP). This paper explores AI-based assessment in education (AIED), focusing on its benefits and challenges for assessing critical thinking in diverse students post-Chat GPT. It covers AI-enhanced assessment for learning to promote diversity and cultural responsiveness, biases in AI technologies, and AI-assisted critical thinking assessment. Three benefits of AI include adaptive assessments, multimodal assessments, and personalized feedback. Ethical concerns include understanding AI limitations, ensuring ethical use, and representing diverse content in a multilingual society.

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1. Introduction

Since policies on *artificial intelligence in education (AIED)* are in place, teachers' over-reliance on using *artificial intelligence (AI)* for assessment poses a severe threat to students' learning motivation, academic experience, data privacy, and civil rights (Ali et al., 2023). Institutional policies that either permit with some conditions or completely prohibit the use of *generative artificial intelligence (GenAI)*, more than half of teachers report that secondary students have used GenAI for school purposes, followed by middle and primary teachers (Center for Democracy and Technology, 2024)

As non-AI experts, academic staff navigate GenAI to produce alternative assessments, craft personalized learning journeys, cater to student needs, and create immersive scenarios deep into subjects from multifaceted perspectives. Therefore, it is vital to equip academic staff with responsible and safe foundational skills that assist them in making assessments with ethical reasoning in an AI-infused world (Tang et al., 2024).

This article aims to provide a fundamental understanding of AI-infused assessment to develop students' critical thinking, while also acknowledging affordances and constraints concerning ethical underpinnings that surround teachers, curriculum specialists, school leaders, policymakers, and researchers to navigate in balancing the capacities of AIED for innovative pedagogy.

2. Definition of Terms

Artificial Intelligence (AIED)

Artificial Intelligence in Education (AIED) refers to the use of AI technologies or applications in educational contexts to improve teaching and learning processes. AIED entails building AI-driven educational tools, enabling systems to support learning activities, and establishing computer models of human capabilities. AIED framework constitutes learning about AI, and teachers learn with AI (Kucina et al., 2020).

Holmes et al. (2019) categorize the purposes of AI applications to support teachers facing AI regarding language learning, augmented and virtual reality, automatic writing evaluation, chatbots, dialogue-based tutoring systems, immersive learning environments, intelligent tutoring systems, ITS+, learning analytics and learning network orchestrators.

Assessment

Assessment is defined as "a tool, a process, an event or a judgment" given to students to provide what is learned (Taylor & Nolen, 2022, p.3). Teachers increasingly leverage AI assessment tools to assist in their decision to support students' intersection of race, culture, special needs, and personal identities. In addition, understanding algorithms and data in designing and implementing AI-integrated learning activities to apply principles of *culturally relevant pedagogy (CRP)* and improve the validity, teaching with AI assists teachers in being aware of potential biases in AI, which is considered a property of assessment for learning tools (Ladson-Billings, 1995).

3. Assessment for Learning in the Age of AI

Assessment of Learning is associated with purposeful feedback related to learning goals (Taylor & Nolen, 2022, p.66). *The National Assessment of Educational Progress (NAEP)* suggests that a standards-based curriculum contributes to inequity for *English learners (ELs)*, students of color, and low-income students. The number of immigrants is continuously growing in mainstream US education (US National Center for Education Statistics, 2023). Nevertheless, assessment practices are governed by conventional socially constructed systems that affect disadvantaged students' interpretation, directions, and feedback of assignments with oppressive impacts owing to deficit culture accounted for by traditional instructional and assessment practices (Swiecki, 2020).

My background in *Teaching English to Speakers of Other Languages (TESOL*) in Higher Education motivates me to look into the "situative lens," making students, who are nondominant groups in the US, assessed

in a more just and equitable way with AI-driven technologies (Hickey & Harris, 2021). AI alters teacher assessment for learning, lesson planning, and creative and personalized learning activities, challenging cognitive problems of underserved students (Cope et al., 2022).

Potential Assessment Biases from Leveraging AI Technologies

Bias in assessment refers to "equal ability from different demographic groups having an unequal likelihood of doing well due to assessment tools for the assessment processes" (Taylor & Nolan, 2022, p.52). Bias in assessment occurs when teachers' attitudes or beliefs about a student's specific group affect assignment evaluation and expectation of their performance with vague evaluation criteria. Acknowledging biases is essential to uphold fairness and validity—the very foundation of truthful assessment—by mitigating obstacles arising from teachers' perceptions and beliefs, including non-academic considerations and grading policies (Jackson & Panteli, 2023). Although AI reduces the complexity for teachers in interpreting academic standards or learning objectives when evaluating student performance, its algorithms are criticized for issues such as 'hallucinations' and false positives. This is evident when harnessing AI's potential in assessment for learning—for instance, grading software employing summary dashboards that may inadvertently misrepresent student learning (Li et al., 2023). Thus, teachers neglect their expertise, thoughtful development, and trustworthiness assessment due to over-reliance on AI-powered tools.

— First, designs are influenced by cultural biases as content and questions derive from certain cultural norms and knowledge of specific groups. As a result, disadvantaged students or marginalized communities are likely to be underrepresented to "detrack" the threatened validity resulting from assessment bias (Taylor & Nolan, 2022, p.21).

— Second, AI-based assessments rely heavily on *large language models (LLMs) and natural language processing (NLP)*, which leads to language bias, especially for newcomers or students

with different linguistic backgrounds, which generates inaccurate evaluations of their actual academic abilities, which incline to teachers' "self-fulling prophecy", relevant to teachers' judgment, on student ability and behavior and inherited intelligence of students from the nondominant group (Crompton, 2017).

— Third, the algorithms and data established in AI performing assessment systems may reflect the biases of training data related to race, gender, socioeconomic status, or other demographics (Baker& Hawn, 2022). These factors may not completely represent the actual diverse student populations to evaluate this discrete knowledge and skills intended to represent required for student learning and development.

Assessing Students' Critical Thinking by Harnessing the Power of AI

My experience teaching ELs makes me acknowledge that students commonly consider their inability due to "biodeterminism" and need a more holistic view of their abilities rather than standard-based assessment (Gould, 2008, p.34). A comprehensive assessment using AI allows teachers to improve teaching quality as well as increase enthusiasm and motivation, while enhancing their required modalities of skill development (Wang, 2017). Moreover, this approach promotes interdisciplinarity, not limited to language learning, to capture real-world abilities. They should account for intra-individual variability in performance across different contexts and times, with our course team's consensus on the interpretation of measurement (Gould, 2008).

I intended to explore AI in assessment due to the following reasons:

— First, critical thinking is one of the most desirable characteristics for knowledge application, making education an "equalizer" (Darby, 2018, p.2) with ethical assessment in striving for volatility, uncertainty, complexity, and ambiguity (VUCA).

— Second, my work experience is related to curriculum development in preparation for undergraduate students to overcome "unconscious bias" with 21st-century skills for their future careers (Adam et al., 2023).

— Lastly, alternative assessment has been increasingly popular for language assessment instead of deploying traditional international standardized tests or standards and reframing our assessment influenced by "reductionism" (Gould, 2008, p.27).

I have a keen interest in developing students holistically by applying critical language awareness, as teaching a language also involves cultural influences. Assessing students' critical thinking is part of 21st-century skills. AI has the capacity to analyze data and predict academic behaviors, curriculum design, holistic assessment, and supportive learning environments (Yousafzai et al., 2020). AI-powered assessment tools offer adaptive assessment, multimodal assessment, and personalized feedback to improve authentic assessment and assist teachers in tailoring teaching strategies (Benotti, 2018).

Teachers are required to critically evaluate AI tool assessments for equitable and comprehensive education with AI capabilities, including personalized learning and multimodal and real-world applications. On the other hand, teachers need to navigate the evolving landscape of AIED, dealing with its limitations, ethical considerations, and data representation to foster a balanced approach to cultivating critical thinking (Murphy, 2019).

AI-based assessment tools provide students with more comprehensive, efficient, and data-driven evaluations of critical thinking (Henry et al., 2021). However, teachers need to consider reliability, validity, and ethical implications while embracing emerging technology to ensure inclusivity and equity within education settings.

There is a growing interest in exploring AI pedagogy and assessment practice after the introduction of Chat GPT in 2022. The most recent AI evaluation and assessment has been conducted in academic articles,

resulting in holistic investigations on multiple impacts of AI in assessment for learning in compliance with the *Every Student Succeeds Act (2015)*, which revised the *No Child Left Behind (2001)* education legislation (Yang et al., 2021). Process-oriented evaluations are valued to cultivate higher-order cognitive abilities such as critical thinking rather than traditional standardized tests. The performance-based critical thinking assessment effectively captured meaningful differences in students' critical thinking skills and positively impacted developing alternative evaluation (Gresse Von Wangenheim et al., 2022).

The benefits of AI use to assess critical thinking skills include:

— Adaptive Assessment: AI-powered assessment adjusts the difficulty and type of questions based on a student's responses, providing a more personalized and accurate evaluation of their critical thinking skills. As a result, teachers are enabled to identify strengths, weaknesses, and areas for improvement (Wu, 2024). AI tools can be used for automated essay scoring, offering critical analysis, argumentation, and writing abilities with an assessment more based on open-ended, higher-order thinking tasks (Hadzhikolev et al., 2022).

— Multimodal Assessments: AI tools can integrate various data sources and facilitate students' thought processes, creativity, and metacognitive skills, such as multimedia responses, higher-order thinking skills, and behavioral analytics, to provide a more inclusive evaluation of critical thinking abilities (Volante, 2023). Assessment formats serve as alternative explanations for differences in students' responses to minimize language complexity bias in assessment, for example, technical vocabulary, multi-meaning, multi-meaning words, idiomatic phrase sentence length, dependent clauses, and multiple prepositional phrases (Delgado, 2020).

— Personalized Feedback and Interventions: By analyzing student performance data, AI-based assessment systems can generate

personalized feedback and recommend targeted learning interventions to help students improve their critical thinking skills (Kouzov, 2019).

The AI adoption for assessing critical thinking has several challenges:

— Being aware of AI Capabilities and Limitations: Teachers should be knowledgeable about the capabilities and limitations of AI assessment tools (Wu, 2024). This foundational knowledge aids teachers in recognizing their positive and negative traits, allowing more effective and ethical assessments and balancing the use of technology with an assets-based approach, critical thinking, and creativity (Liang, 2023).

— Ethical Use of AI: One of the critical components of AI literacy is the ethical use of AI. Teachers should recognize issues related to data privacy, implicit bias, stereotypes, and potential misuse reflecting the "othering" perspective (Cope et al., 2020). Teachers who are instilled with a solid ethical foundation will be able to use AI tools responsibly in assessment (Kouzov, 2019).

— Diverse Content Representation: AI contains trained "over-representation" data by Western developers exhibiting stereotypes and misrepresentations of a specific group (Swiecki et al., 2022). AI models with a white-dominant culture might not precisely represent the content, language, and image of the fast-growing populations of diverse students, including race, gender, socioeconomic status, and other components. CSP aligns learning goals, producing culturally appropriate tasks and avoiding cultural inconsistency to attain cultural competence and challenge the existing order to be active citizens in a democratic society (Blanchard & Mohammed, 2024).

4. Recommendations

Further research could combine AI tools with other professional development strategies among teachers from different subject areas in the

following aspects. First, teachers should maintain a human-in-the-loop approach and be conscious of biased algorithms, data sources, and model development processes used by the AI assessment tools as well as the limitations of the system (Akgun & Greenhow, 2022). Second, teachers assess the performance of the AI system across diverse student populations for fairness and bias to identify any disparities or disproportionate impacts (Nazaretsky et al., 2022). Third, teachers collaborate with students, families, and community stakeholders to understand how AI-based assessments affect different groups (Du, 2020). Lastly, teachers ensure validity and reliability for clear explanations of how the AI system arrives at its assessment results transparently, avoid reliance on AI-based interpretation, and prepare to adjust the assessment process (Woodruff et al., 2023).

In conclusion, this article provides comprehensive research on using AI-based assessment for learning. Critical thinking underscores the need for continued research, collaboration, and professional development to ensure the responsible and equitable implementation of technologies supporting student learning and development. It is evident that enhanced assessment offers a valuable approach to evaluating student intellect to meet the demands of the 21st century. Nevertheless, this assessment method requires ethical consideration in measuring and fostering students' practical skills and knowledge application.

The latest development of AI integration and AI-powered tools for adjustable assessment should address moral questions arising in line with the roles of teachers to encompass transparency in support of decision-making, ensure equitable design, and validate alignment with curriculum objectives. Responsible AI prioritizes data privacy, inclusivity, and fairness, providing a culture of interdisciplinary collaboration and upholding critical thinking, accuracy, and standards in educational settings.

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6. Short Biography

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