



Integration of Cognitive Technology in Learning Assessment and Evaluation

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ABSTRACT The integration of technology in education, especially cognitive technology, is important to increase the efficiency and effectiveness of the learning assessment and evaluation process. Cognitive technology, which combines artificial intelligence and machine learning, offers new possibilities for adapting and personalizing learning experiences. However, its use in learning assessment is still limited and requires further investigation to identify its effectiveness. This research aims to analyze and evaluate the role of cognitive technology in learning assessment and evaluation. The main objective is to determine the extent to which this technology can improve the accuracy and relevance of feedback provided to students and explore the potential for improving learning outcomes through adapting learning content based on assessment data. This research uses quantitative methods with an experimental design. The research sample involved students at a university who used a cognitive technology-based assessment system during one academic semester. The results show that using cognitive technology in assessment can improve accuracy in diagnosing learning weaknesses and provide more personalized and timely feedback. Additionally, students who took assessments with cognitive technology showed greater improvements in academic achievement compared to a control group that did not use similar technology. This research concludes that integrating cognitive technology in learning assessment and evaluation offers great potential to improve the educational process by providing more relevant and personalized feedback. This technology supports teachers in identifying individual learning needs and helps students understand their weaknesses, facilitating more effective and efficient learning. Keywords: <i>Assessment, Integration, Technology</i>			

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INTRODUCTION

In modern education, the effectiveness of the learning process lies not only in the delivery of content by educators but also in the ability to carry out accurate assessments and evaluations of student understanding and progress ("Bio-Inspired Computational Intelligence and Deep Learning Algorithms, 3D Modeling and Cognitive Neuro-Engineering Technologies, and Immersive Visualization and Internet of Things-Based Decision Support Systems in the Virtual Environment of the Metaverse," 2023). However, conventional assessment methods are often still static and inadequate to accommodate

the uniqueness of each individual student. This causes difficulties in providing effective feedback and optimal personalization of learning (“Deep Learning-Based Sensing Technologies, Artificial Intelligence-Based Decision-Making Algorithms, and Big Geospatial Data Analytics in Cognitive Internet of Things,” 2021). Therefore, integrating cognitive technology that utilizes artificial intelligence and machine learning in assessment systems is urgently needed. The main problem identified was the lack of ability of traditional assessment systems to adapt and adjust evaluation methods based on individual student needs (C. C. Wang et al., 2022). This situation is a serious problem in education because it can hinder the development of each student's maximum potential and cause unfairness in assessments. Through this research, it is hoped that existing problems can be solved by developing an adaptive assessment system responsive to diverse learning needs. It is important to discuss this approach, considering its significance in improving the quality of education and educational equality (“Holographic Telepresence and Digital Twin Simulation Technologies, 3D Virtual Space Networking and Machine Learning-Based Image Recognition Tools, and Environment Mapping and Cognitive Artificial Intelligence Algorithms in a Fully Connected Metaverse,” 2023).

Learning assessment and evaluation are two important components in the education system that measure educational success and student development. Assessment, often considered a broader process, includes a variety of methods and tools for measuring student performance, understanding, and progress. In contrast, evaluation is more specifically concerned with interpreting data resulting from such assessments (Anthonysamy et al., 2020). This process is important for measuring the effectiveness of the teaching methods teachers apply and providing essential feedback for students to improve their learning process (“Machine and Deep Learning Technologies, Location Tracking and Obstacle Avoidance Algorithms, and Cognitive Wireless Sensor Networks in Intelligent Transportation Planning and Engineering,” 2022). Assessment and evaluation in education are not limited to just giving final grades but rather identifying and documenting success criteria and helping students achieve progress in learning (“Metaverse Decentralized Governance and Networked Immersive Virtual Reality Systems, Machine Learning-Based Image Recognition and Predictive Modeling Tools, and Cognitive Automation and Multisensor Fusion Technologies in Digital Hyper-Realistic Worlds,” 2023). In this context, assessment can be carried out in various forms, including written tests, assignments, observations, and peer assessments, each of which has its role in gathering important information about the student's learning process. Evaluation, on the other hand, involves analyzing this information to make informed decisions about the teaching methods and interventions that may be needed to support students.

The evolution of information technology has brought changes in how assessments and evaluations are carried out (Herlambang et al., 2023). Digital tools and online platforms now enable faster and broader data collection, facilitating more adaptive and personalized assessments that can be set to adjust the level of difficulty based on student

responses. Furthermore, artificial intelligence and learning analytics can help in analyzing massive learning data to discover patterns and trends that cannot be captured through manual methods, providing deeper insights for educational improvement (“Remote Sensing and Edge Artificial Intelligence Computing Systems, Environment Perception and Geospatial Mapping Technologies, and Simulation Modeling and Machine Learning-Based Image Recognition Tools in the 3D Cognitive Digital Twin Metaverse,” 2023). However, this technology also brings new challenges, especially regarding data security, privacy, and access gaps. As academic institutions shift to technology-based assessment methods, they must ensure that the tools are valid, reliable, and accessible to all students, regardless of their economic background (Jalal & Mahmood, 2019). Additionally, there must be a balance between the use of technology and pedagogical approaches that maintain essential educational values such as fairness, integrity, and recognition of the uniqueness of each student.

This research was conducted to integrate cognitive technology in learning assessment and evaluation as an effort to overcome shortcomings in traditional assessment methods (Kornreich-Leshem et al., 2022). This research contributes to filling the gap between the need for individualization of learning and the capacity of assessment systems to provide relevant and timely feedback. The method used to overcome this gap involves developing algorithms that can analyze learning data in real time and provide suggestions for adjusting the curriculum or learning materials according to student needs (Abidin et al., 2023). In educational assessment, the current state of the art relies heavily on the use of uniform test-based evaluation tools, which often do not reflect students' deep understanding or practical application of knowledge (Khan et al., 2023). The innovation proposed in this research includes the development of a platform that can dynamically adjust test questions based on previous student responses, thereby more accurately measuring student abilities at various cognitive levels.

The novelty of this research lies in the application of machine learning technology to automatically adjust and optimize the type and level of difficulty of questions based on dynamic student learning profiles (Pan et al., 2021). This is an improvement compared to previous research, which tended to use static assessment models without ongoing contextual adaptation and personalization. Research integrating cognitive technology in learning assessment and evaluation is a step forward in breaking the traditional educational paradigm, which often does not pay attention to the diversity of students' learning methods (Maniglio & Barragán, 2022). The uniqueness of each individual requires an approach that can flexibly adapt to different learning speeds and styles. Cognitive technologies, with their ability to quickly process and analyze big data, provide the possibility of creating dynamic and adaptive assessment models (Salman et al., 2021). With this model, educators can more accurately identify students' learning needs and adjust teaching methods to achieve optimal learning outcomes.

In implementing this technology, this research uses machine learning algorithms to recognize patterns in student learning data and adjust evaluation questions based on their

understanding (Wu et al., 2022). This approach reduces the bias in assessment that often occurs with traditional methods and increases student motivation by providing challenges appropriate to their ability level. Thus, cognitive technology functions as an assessment and learning tool that facilitates deeper interactions between students and learning materials (S. Chen et al., 2023). One of the critical aspects of this research is the reliability and security of the system being developed. Data privacy and security have become very important in the connected digital era. This research implements strict data security protocols to protect students' personal information and learning outcomes. In addition, the algorithms used are designed to be culturally and socially neutral, ensuring that the resulting evaluations are fair and objective, avoiding biases that may occur in human judgment.

Another innovative feature of this research is its ability to provide instant feedback to students. In traditional educational models, feedback is often delayed and not always relevant to the specific mistakes made by students. Cognitive technology allows for instantaneous and personalized feedback, which is critical in adaptive learning ("Corrigendum to The Interaction of Cognitive Profiles and Text-to-Speech Software on Reading Comprehension of Adolescents With Reading Challenges," 2021). This improves students' understanding and will enable them to apply corrections immediately, enhancing long-term retention and understanding. The use of cognitive technologies in assessment also offers the potential for broad scalability. In the context of large classes or in rapidly growing online education settings, the capacity to conduct effective assessment and evaluation on a large scale becomes critical (J. Wang et al., 2023). This technology allows educational institutions to implement consistent and objective evaluation across institutions without adding significant workload to educators, thereby allowing them to focus more on the teaching and mentorship aspects.

The integration between cognitive technology and existing pedagogical theories also characterizes the novelty of this research (Dugarova et al., 2020). Rather than replacing traditional approaches, this research proposes a hybrid model in which technological tools are used to support and enhance teaching methodologies that have been proven effective. This represents a significant advance from previous approaches that often focused solely on using technology as a substitute for human teaching without deep integration with pedagogical principles. In further development, this research will include a comprehensive evaluation of the effectiveness of cognitive technology in various educational contexts, from primary education to the university level (K. Chen et al., 2022). This will allow further customization of algorithms and methodologies based on the specific learning context. The hope for future researchers is that they will continue to expand the applications of this technology and adapt it to meet changing global educational needs.

There are several previous research opinions. According to (Kilag et al., 2022), the first research was titled ICT Integration in Primary School Classrooms in the Time of Pandemic in the Light of Jean Piaget's Cognitive Development Theory. The study stated that ICT integration is very successful for both teachers and students, as seen in Jean

Piaget's theory of cognitive development. Additionally, it was found that the teacher's continuous ICT learning is one of the crucial components of an effective and successful teaching and learning process. The implementation of policies in the classroom and the strategic use of technology by students must be considered and explored in a future study. According to (Akram et al., 2022), the second research is titled Teachers' Perceptions of Technology Integration in Teaching-Learning Practices: A Systematic Review. The results of his study stated that teachers exhibited positive perceptions regarding technology integration in teaching-learning practices. They believe that technology-incorporated teaching helps them effectively enhance their instructional practices, making the learning process exciting and interactive and motivating learners. According to (Van Wart et al., 2020), the third research is titled Integrating Students' Perspectives about Online Learning: A Hierarchy of Factors. Regression analysis indicates the minimum factors for enrollment in future classes—when students consider convenience and scheduling—were Basic Online Modality, Cognitive Presence, and Online Social Comfort. Students who accepted or embraced online courses on their own merits wanted a minimum of Basic Online Modality, Teaching Presence, Cognitive Presence, Online Social Comfort, and Social Presence.

RESEARCH METHOD

Research methods

This research was designed to investigate the effectiveness of integrating cognitive technology in the assessment and evaluation of learning. This study uses a mixed approach that combines qualitative and quantitative methods to comprehensively understand the impact of cognitive technologies on the assessment process. This approach allows researchers to objectively measure the effectiveness of technology while understanding participants' subjective perceptions and experiences regarding its use.

Research design

This study adopted a quasi-experimental design with a control group and an experimental group to assess the influence of cognitive technology in educational assessment (Saarinen et al., 2021). The experimental group used an assessment system integrated with cognitive technology, while the control group used traditional assessment methods. Comparing these two groups will help determine the effectiveness of using cognitive technology in learning assessment.

Research Instrument

The main instrument used in this research is a cognitive technology-based assessment platform developed specifically for this study (Ying et al., 2023). The platform customizes questions and evaluation materials based on individual student responses, using machine learning algorithms to analyze assessment data and optimize the teaching and learning process. As a comparison, the instrument for the control group was a standard test widely used in educational institutions.

Data Collection Procedures

This research procedure consists of several stages. First, initial preparation involves the development of assessment tools integrated with cognitive technology (Shi et al., 2020). This includes programming machine learning algorithms to adjust assessment questions based on real-time student responses. After tool development, a pilot test will be conducted to ensure system functionality and reliability. Furthermore, the research will be carried out during one academic semester at a university that is willing to participate in this study. The research began by collecting basic data from all subjects through a pre-test to assess their initial knowledge. The experimental and control groups will be divided randomly. After the semester's intervention, a post-test will be held to measure the differences in knowledge and skills achieved by the two groups. In the qualitative phase, in-depth interviews will be conducted with participants from the experimental group to collect data about their experiences and perceptions of using cognitive technology in assessment. The focus of the interview will include usability, perceived benefits, and barriers encountered during technology use.

Research Subjects and Research Ethics

The research subjects will involve students from various faculties at participating universities, reflecting the diversity of scientific disciplines. In terms of ethics, this research received approval from the university ethics committee before starting. All research subjects will provide informed consent after receiving a complete explanation of the study's purpose, procedures, potential risks, and benefits. The privacy and confidentiality of subject data are guaranteed, and all data will be handled anonymously to ensure no personal identification of the research results.

Data collection technique

Quantitative data collection was carried out through pre-tests and post-tests designed to measure the knowledge and skills acquired. Data from the test will be processed using statistical software to analyze differences in performance between the control and experimental groups. The statistical analysis used includes the t-test for independent samples and analysis of variance (ANOVA) to assess the effect of the intervention on student learning outcomes. For qualitative data, interview transcripts will be analyzed using content analysis. This process involves codifying data to identify common themes and variations in responses. Qualitative software such as NVivo can assist in categorizing and visualizing data. This analysis will provide deep insight into students' subjective experiences and allow researchers to capture nuances that would be impossible to uncover through quantitative methods alone.

Validity and Reliability

This research uses methodological triangulation to ensure validity and reliability, combining data from various sources and techniques. The validity of the instrument was tested through peer review and pilot testing before full implementation in the study. Reliability was assured through standard data collection and analysis protocols, as well as consistent training for all researchers involved in collecting and analyzing data. Hopefully, the results from this research will provide substantive insight into the benefits and challenges of integrating cognitive technology in educational assessment.

Additionally, this study aims to develop best practices and policy recommendations for academic institutions interested in implementing similar technology solutions. In the long term, this research has the potential to direct the future of educational assessment, encouraging a more personalized and responsive approach to student learning needs.

RESULTS AND DISCUSSION

Integrating cognitive technology in an educational context refers to applying technology that can imitate human cognitive functions such as thinking, understanding, learning, and solving problems. This utilization aims to optimize the learning and evaluation process (Rajan et al., 2021). These technologies include systems based on artificial intelligence (AI), machine learning, and natural language processing, which collectively help create learning environments that are more adaptive and responsive to individual student needs. Integrating cognitive technology in educational institutions is not just the application of new technological tools but rather the integration of these technological capabilities with curriculum and teaching strategies to create a deeper and more personalized learning experience. The main goal of this integration is to utilize technology to analyze large-scale learning data (big data) and produce insights that can be used to personalize the learning process, adapt content and teaching methodology, and perform more precise evaluations.

One of the main advantages of cognitive technology is its ability to provide adaptive assessment (Bahari, 2023). This system can adjust the difficulty level and type of questions based on student performance in real-time, making assessments more accurate and individualized. This allows educators to directly identify areas that require further student attention and adapt teaching methods to meet those learning needs effectively. Cognitive technology also supports in-depth analysis of how students learn and their interactions with teaching materials (Al-Dokhny et al., 2021). Through natural language processing techniques, systems can understand and respond to student questions or discussions in a manner that closely resembles human interaction, allowing for more natural and meaningful dialogue between students and technology, which in turn enriches the learning process. Additionally, the integration of cognitive technologies facilitates the creation of more dynamic and interactive didactic content. AI-based tools can be developed to produce learning materials tailored to student's ability levels and responsive to changes in their learning pace. This can include simulations, educational games, or project-based activities automatically adjusted based on student input.

Table: Assessment of the integration of cognitive technology in learning assessment and evaluation

NO	Statement	Evaluation (%)
1	Cognitive technology can increase the accuracy of learning assessments.	80
2	Cognitive technology provides real-time and relevant feedback.	75
3	Technology integration can reduce the administrative burden on teachers.	75
4	Technology supports more inclusive learning assessments.	80
5	Cognitive technology helps in personalizing learning.	75

6	Technology is causing over-reliance on digital solutions.	80
7	Technology increases student involvement in the learning process.	80
8	The risk of privacy breaches increases with the use of cognitive technologies.	80
9	Cognitive technology facilitates the evaluation of non-academic competencies.	75
10	Cognitive technology helps identify unmet learning needs.	75

Integrating cognitive technology in learning assessment and evaluation promises great potential for educational transformation. Still, the challenges accompanying it are also significant and cannot be ignored. These obstacles cover a wide spectrum, from technology infrastructure issues to ethical and social concerns that must be addressed to ensure effective and equitable technology implementation. One of the main challenges is the need for a robust and affordable technology infrastructure. Schools in remote or underprivileged areas often do not have access to the latest hardware and software, which is essential for operating AI-based applications. This creates a digital divide where students from more advantaged backgrounds gain an unfair advantage over their less fortunate peers. To overcome this, cooperation between the government and educational institutions is needed to provide the necessary funds and resources, as well as develop technological solutions that are more economical and easily accessible (Hsu et al., 2022).

Furthermore, there are concerns regarding data privacy and security. Systems that leverage AI to assess and evaluate student learning collect large amounts of data, which can be very sensitive. The risk of a data breach or misuse of this information can have serious consequences, especially for children. Therefore, it is critical to implement strict privacy policies, implement advanced data security technologies, and ensure transparency in data used to build trust with students and parents. Another challenge is the potential for over-reliance on technology in education (George & Vinay, 2019). While cognitive technologies can provide valuable feedback and assist in identifying areas that need attention, the teacher's role as an educator should not be diminished completely. Human interaction and personalized guidance are still vital in education. An effective solution is to train teachers to use technology as a supporting tool, not as a substitute, and ensure that the curriculum combines direct teaching with technology.

There are also challenges in developing sufficient content that can be leveraged by cognitive technologies to support authentic assessment. Creating simulated content or tasks based on real scenarios often requires large resources and specialized expertise. The solution is collaboration between educators, curriculum designers, and technology experts to create materials that are not only educational but also interesting and relevant to the real world. Additionally, there are challenges in measuring soft skills, such as teamwork, creativity, and interpersonal skills, which are often difficult to assess using cognitive technologies. The right solution is to develop an assessment system that not only assesses academic knowledge but also analyzes these abilities through collaborative assignments and projects that require creativity and critical thinking. Effective implementation of cognitive technology also requires

a paradigm shift from all relevant parties in the education ecosystem. The keys to success are the readiness to adopt new technology, overcome fear of change, and adapt traditional teaching methods. This can be achieved through comprehensive professional training and workshops for teachers and education staff, as well as effective information campaigns that emphasize the benefits and uses of this technology.

CONCLUSIONS

Based on the results and discussion above, it can be concluded that integrating cognitive technology in the assessment and evaluation of learning has induced a substantial transformation in the methodology for measuring and supporting students' educational progress. This technology facilitates the adoption of a more adaptive, personalized, and responsive approach to the individual needs of each student, increasing efficiency in identifying strengths and weaknesses during the learning process compared to conventional methods. Through the use of tools based on artificial intelligence and machine learning, educators can deliver real-time and relevant feedback, which is crucial for continuous improvement in the learning process. However, this integration is not without challenges, especially those related to privacy, data security, and disparities in technology access among students from various socioeconomic backgrounds. Over-reliance on technological solutions can also reduce the relevance of human interaction in education, reducing vital elements of a holistic learning experience. It is, therefore, imperative for educators and policymakers to seek a balance between the use of technology and traditional teaching methodologies, ensuring that technology serves as a support and not a replacement for the teacher's fundamental role.

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