AI AS A TUTOR

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Abstract - *This survey paper presents a comprehensive exploration of Artificial Intelligence (AI) systems functioning as tutors, encompassing related works, comparisons, and future scope. The review delves into various methodologies, algorithms, datasets, and applications employed in AI tutor systems. It synthesizes existing literature to shed light on the evolution of these systems, providing insights into challenges faced and advancements achieved. Through comparative analyses, the paper discusses and contrasts different approaches, offering a critical perspective on their effectiveness. The survey also outlines potential future directions and areas for improvement in AI-based tutoring. Aimed at scholars, professionals, and enthusiasts, the paper serves as a valuable resource to stimulate further innovation and understanding in the dynamic field of AI tutoring.*

*Key Words***: AI Tutoring, Intelligent Tutoring Systems (ITS), Personalized Learning,Online Learning, Tutoring Systems Evaluation, Student Engagement.**

1. INTRODUCTION

In the contemporary landscape of education, the infusion of Artificial Intelligence (AI) has ushered in a paradigm shift, revolutionizing the way we perceive and engage with learning. One of the remarkable manifestations of this transformation is the emergence of AI tutors, intelligent systems designed to guide and support learners in their educational journey. As traditional teaching methods undergo a digital metamorphosis, AI tutors stand at the forefront, offering personalized, adaptive, and data-driven approaches to education. This review delves into the multifaceted realm of AI as a tutor, exploring the diverse methodologies, applications, and implications of these intelligent systems. By examining related works, drawing comparisons, and outlining future prospects, we aim to provide a holistic understanding of the current state and potential advancements in AI-driven educational tutoring.

2. LITERATURE SURVEY

In the paper [1] " The Research on the Role of Online Tutor and the Learning Activity Organization Strategies" by Nan Wang and Ai-ling Qiao examines strategies for developing effective online learning models, with a focus on the crucial role of online tutors. Given the emphasis on utilizing information technology to improve education in China, the

authors analyze common challenges in web-based learning. They propose that online tutors are critical to drive student engagement and learning outcomes. The paper suggests online tutors should facilitate structured learning experiences by designing meaningful tasks and moderating collaborative discussion forums. Additionally, tutors should provide customized support based on the specific curriculum and needs of individual learners. Overall, the authors recommend that online instructors embrace their role as guides and enablers of self-directed online learning. With proper tutor participation, web-based education can become more impactful. The paper aims to encourage teachers to actively support students in online environments, in order to enhance the effectiveness of technology-enabled instruction. Further research could continue investigating optimal online teaching strategies.

The research paper [2]"Understanding the Factors Influencing Higher Education Students" Intention to Adopt Artificial Intelligence-Based Robots" by Mohammed A. M. Algerafi, Yueliang Zhou, Hind Alfadda, and Tommy Tanu Wijaya, investigates Chinese higher education students' willingness to adopt AI-based robots for educational purposes. Applying the Technology Acceptance Model (TAM) 3, the study proposes 14 hypotheses, revealing that 12 were accepted. The results suggest a positive inclination among students to embrace AI-based robots in education. However, job relevance and robot anxiety were found to have insignificant impacts on perceived usefulness and ease of use, respectively. The study offers valuable insights for university administrations, robot developers, policymakers, and administrators in designing and implementing AI-based robots to meet contemporary educational needs.

The research paper [3] "Artificial Intelligence in Education: A Review" by Lijia Chen, Pingping Chen, and Zhijian Lin, explores the impact of Artificial Intelligence (AI) on education. Focusing on administration, instruction, and learning, the study utilizes a qualitative approach and literature review to assess AI applications. It reveals the

extensive adoption of AI in education, evolving from computer technologies to web-based systems and humanoid robots. AI systems, including web-based chatbots, independently perform administrative and instructionalStasks, enhancing efficiency in grading and teaching quality. Notably, machine learning enables personalized curriculum and content, aligning with students' needs, thereby improving uptake, retention, and overall learning experiences. The study provides valuable insights into the transformative effects of AI on various facets of education.

The paper titled [4] "Personalized Adaptive Learning Technologies Based on Machine Learning Techniques to Identify Learning Styles: A Systematic Literature Review" by Saadia Gutta Essa, Turgay Celik, and Nadia Emelia Human-Hendricks delves into the use of artificial intelligence (AI) and machine learning (ML) in personalized adaptive education systems, aiming to overcome the limitations of statically determined learning styles (LSs). Conducting a systematic literature review from 2015 to 2022, the authors analyze influential studies to identify trends and gaps in the literature. The paper highlights the application of ML techniques to dynamically map students' behavioral attributes to specific LSs, optimizing individual learning processes. The review explores LS models, ML techniques, platforms stimulating research, evaluation methods, and learning support. The findings indicate a growing interest in employing artificial neural network approaches for LS identification, with a notable gap in the comparison of deep learning methods. The study underscores the need for further empirical investigation and documentation of the adoption and comparison of deep learning algorithms in classifying LSs to enhance adaptability in e-learning environments. Overall, the paper provides insights into the evolving landscape of personalized adaptive learning technologies and the role of ML in identifying and accommodating diverse learning styles.

The research paper [5] "Research on the Design and Implementation of Intelligent Tutoring System Based on AI Big Model" byWenjing Shi,Zhuming Nie and Yuhan Shi presents research on developing an intelligent tutoring system using large AI models to provide personalized and adaptive learning support. The system utilizes deep learning algorithms and big models to analyze each student's data and learning patterns in order to build a customized learning profile. Based on this profile, the system can tailor tutoring to individual students by generating personalized learning paths, recommending appropriate teaching resources, and providing real-time feedback and assessment. The goal is to simulate an actual teacher's guidance to help students better comprehend and apply knowledge across various subjects. The researchers adopt advanced AI techniques and computing platforms to create an efficient, scalable, and user-friendly system interface. Overall, this intelligent

tutoring system leverages the capabilities of AI big models to offer individualized tutoring and has the potential to enhance student learning outcomes and engagement. Further research could focus on optimizing the system to accommodate different learner needs and educational objectives.

In paper titled [6] "AI and Machine Learning Techniques in the Development of Intelligent Tutoring System: A Review" by Fatema AlShaikh and Nabil Hewahi provides a comprehensive review of research on intelligent tutoring systems (ITS) that leverage artificial intelligence and machine learning techniques. ITS aim to provide personalized and adaptive learning support by emulating human tutors. The authors describe the architecture of ITS, which incorporates student modeling, domain knowledge, pedagogical modules, and user interfaces. Key AI and ML approaches used in ITS include reinforcement learning, artificial neural networks, clustering algorithms, Bayesian networks, and fuzzy logic. These techniques enable capabilities such as customized feedback, intelligent problem solving support, and knowledge assessment. The authors summarize current ITS implementations and ongoing research efforts to enhance these systems using the latest AI innovations. Challenges include developing more accurate student models, scalable platforms, and capabilities for new subject domains. Overall, the review highlights the vital role of AI in building ITS that can dynamically adapt to individual students and improve outcomes through one-on-one intelligent tutoring. Further advancements in AI and ML will continue expanding these systems.

In the paper [7] "Rehearsing Naval Tactical Situations Using Simulated Teammates and an Automated Tutor" by Emilio Remolina,Sowmya Ramachandran,Richard Stottler and Alex Davis describes an Intelligent Tutoring System that trains Tactical Action Officers (TAOs) in the Navy. The system uses simulation and artificial intelligence to provide a virtual training environment. TAOs learn "command by negation," supervising watchstanders who perform duties autonomously, while the TAO intervenes to correct mistakes. The system features Automated Role Players representing watchstanders and a natural language interface for communicating with them. An adaptive coaching strategy provides personalized feedback during exercises. The paper outlines the instructional design, system architecture, and AI techniques, including simulations, automated teammates, natural language processing, and adaptive coaching algorithms that make this specialized training system possible within the practical constraints of deployment on Navy ships.

The paper titled [8] "Individualized AI Tutor Based on Developmental Learning Networks" by Woo-Hyun Kim and Jong-Hwan Kim proposes an individualized AI tutor system to provide personalized educational services to learners. The

system uses three developmental learning networks based on a deep adaptive resonance theory neural network capable of incremental learning. The first network monitors learner status from various inputs to understand the learner's current state. The second categorizes learner preferences based on patterns in their choices. The third reflects updated assessments of educational effectiveness. Combined, these networks allow the AI tutor to dynamically recommend appropriate personalized content for each learner to help them achieve academic success.   The system was implemented in a commercial mobile application for teaching Korean to children. Experiments demonstrate the application's efficiency in assisting children to learn Korean. The proposed AI tutor architecture could be extended to other subjects by training the networks on relevant data.

The paper [9] "Student Modeling and Analysis in Adaptive Instructional Systems" by Jing Liang,Ryan Hare, Tianyu Chang,Fangli Xu,Ying Tang, Fei-Yue Wang,Shimeng Peng and Mingyu Lei presents a review of research from 2010-2021 on student modeling and analysis in adaptive instructional systems. The goal of student modeling is to represent and trace an individual student's knowledge state to inform adaptation. The paper discusses emerging student models based on overlay modeling and data-driven approaches, including variations that address limitations. It also examines the importance of multidimensional learner data, categorized as learning data, physiological data, psychometric data, and environmental data, to improve prediction accuracy. Challenges implementing multimodal learning analytics in real-world classrooms are summarized. An industry case study demonstrates increased model prediction accuracy from 53.3% to 69% by adding modalities. However, uncontrolled data collection led to issues like noise. The paper concludes by offering perspectives on limitations, challenges, and promising future directions for research.

Table -1: COMPARISON OF LITERATURE SURVEY

NAME	ADVANTAGES	DISADVANTAGES
[1]The Research on the Role of Online Tutor and the Learning Activity Organization Strategies	Analyzes Effective strategies for online tutors to support and engage students. Provides guidance on organizing learning activities in a remote environment. Highlights the unique role and best practices for online tutors. Informs training and professional development for online tutors.	Findings may not generalize across different subjects, student age groups and tutoring formats. Practical implementation challenges may be overlooked. Technological capabilities and constraints may not be fully addressed.
[2]Understanding the Factors Influencing Higher Education Students	Provides insight into elements impacting student success beyond just academics. Can identify at-risk students to target support and prevent dropouts. Informs improvements to curriculum, advising, campus resources to better serve students. Focuses specifically on higher education context vs.	Difficult to capture full range of factors influencing each individual student. Findings may not generalize across diverse student demographics and institutions. Self-reported data from students can contain biases. Quantitative correlations do not determine causation. Potential issues with sampling methods providing

	broader education research. Holistic view of student experience using a mixed methods approach.	representative data. Ethical concerns around collection/use of student data. Hard to account for all contextual factors in analysis.	d Adaptive Learning Technologies Based on Machine Learning Techniques to Identify Learning Styles: A Systematic Literature Review	comprehensive overview of research on using machine learning to identify and adapt to different learning styles. Analyzes the capabilities and limitations of current machine learning techniques for personalization. Assesses the validity and reliability of proposed learning style models. Identifies key trends and future directions for adaptive learning technologies. Encourages critical thinking on using learning styles and personalization in education.	learning styles as a concept is still debated among researchers. Review may lack in-depth critical analysis on the quality of studies. Findings could emphasize technological capabilities over practical challenges. Difficult to draw definitive conclusions given the breadth of the review. Research landscape is rapidly evolving, so review findings may quickly become outdated. Ethical implications of data collection and analytics could be explored more.
[3]Artificial Intelligence in Education:A Review	Provides a comprehensive overview of the state of AI technology in educational contexts. Identifies key areas and applications where AI is making an impact on learning and instruction. Analyzes the capabilities and constraints of existing AI systems in education. Highlights major trends and future directions for the field. Encourages critical analysis of the challenges and opportunities associated with AI in education. Promotes discussion around the theoretical foundations and ethical implications of using AI for teaching and learning.	A review may lack sufficient critical assessment of the quality of existing research studies. The breadth of the review could miss depth in analyzing specific AI methods and technologies. Education is a complex domain, difficult to fully capture through a broad AI literature review. Hard to keep current as the field is rapidly evolving. Findings may quickly become outdated. Trends identified may be speculative rather than evidenced-based. The review may emphasize technological capabilities over practical implementation challenges.	[5]Research on the Design and Implementation of Intelligent Tutoring System Based on AI Big Model	Leverages state-of-the-art AI techniques like deep learning for advanced tutoring capabilities. Big models can provide more accurate analysis of student responses and personalized feedback. Can dynamically adjust instruction to each student's knowledge levels and needs. Large training datasets enable	Require extensive computational resources and expertise to develop and maintain. Student motivation and emotion are difficult for AI to evaluate effectively. Adaptability of system is limited by the training data parameters. Student privacy concerns around data collection and surveillance. Tutor interactions may feel impersonal
[4]Personalize	Provides a	The reliability of			

	the system to cover a wide range of topics and scenarios.

AI-powered tutors are more scalable and cost-effective than human tutoring. | or lack nuance without human involvement.

Testing for fairness, transparency and ethics of the AI tutoring is critical but challenging. | | More cost-effective than real-world exercises

Builds teamwork skills with simulated teammates | than critical thinking

Cannot fully replace human team members

Requires substantial programming and maintenance |
| [6]AI and Machine Learning Techniques in the Development of Intelligent Tutoring System: A Review | Provides a comprehensive overview of the state of AI/ML in ITS development.

Analyzes capabilities and constraints of various AI/ML methods for modeling students and personalizing instruction.

Identifies key trends and advancements that show promise for enhancing ITS effectiveness.

Encourages critical analysis of the challenges in implementing AI-powered adaptive learning at scale.

Highlights gaps in research that still need to be addressed. | The breadth of the review results in limited depth/critique of specific AI/ML techniques.

Practical implementation challenges may be overlooked.

Findings could overemphasize technological capabilities rather than real-world limitations.

Hard to provide concrete evaluations and recommendations given the broad scope.

The AI landscape evolves rapidly, so findings may soon be outdated.

Discussion of ethical implications is limited. | [8]Individualized AI Tutor Based on Developmental Learning Networks | Adaptive learning customized to each student's needs and pace

Provides real-time feedback and corrections during learning

Allows learners to progress at their own pace

Reduces need for constant human teacher oversight

Analyzes strengths/weaknesses of learners to focus training | Significant programming required for effective AI tutor

Potential issues with accurately assessing student performance

Lack of human element in teaching/communication

Overreliance could reduce development of critical thinking

Student frustration if system inaccurate or ineffective

Large amounts of data required for tutor to be truly personalized |
| [7]Rehearsing Naval Tactical Situations Using Simulated Teammates and an Automated Tutor | Enables training for difficult-to-recreate scenarios (valuable experience)

Provides automated feedback for improving skills | Lacks realism compared to real-world exercises

Effectiveness depends on simulation/AI capabilities

Could lead to anticipation rather | [9]Student Modeling and Analysis in Adaptive Instructional Systems | Creates customized learning experiences by adapting to each student's level, needs and interests

Provides more targeted and efficient instruction by focusing on areas where students need the most help

Reduces chances of students getting bored or frustrated by | Requires extensive student data collection and complex analysis to build accurate models

Potential for inaccurate student modeling if algorithms are flawed or data is insufficient

Overreliance on system could reduce development of self-directed learning skills

Privacy concerns |

receiving instruction unsuited to their abilities	around data collection and analytics on students
Analyzes student weaknesses and misconceptions to improve instructional content	Difficult to scale system across large student populations and content areas
Models student knowledge, skills and affective states to personalize learning	Does not account well for social, emotional and environmental factors influencing learning

3. FUTURE SCOPE

The future scope of AI as a tutor is expansive, revolutionizing the landscape of education. AI-powered tutoring systems are poised to provide personalized learning experiences, adapting to individual needs and learning styles. These systems are likely to evolve into adaptive learning platforms that continuously assess and adjust the curriculum based on student progress. Global accessibility will be enhanced, breaking down geographical barriers and offering education in diverse languages and cultural contexts. AI tutors are expected to engage in more natural and interactive conversations with students, incorporating multimodal learning approaches. Continuous assessment, immediate feedback, and the integration of emotional intelligence will create supportive and empathetic learning environments. Lifelong learning initiatives will benefit from AI tutors, assisting individuals in acquiring new skills throughout their careers. As technology advances, the integration of augmented reality, virtual reality, and ethical considerations will play a crucial role in shaping the responsible and effective use of AI in education.

4. CONCLUSIONS

A comprehensive examination of related works in AI tutoring reveals a promising landscape for further enhancements. Integrating additional features, particularly visual aids, can significantly augment the efficacy of AI as a tutor. The synthesis of existing research underscores the importance of evolving tutoring systems to cater to diverse learning styles and optimize educational outcomes. As we progress, the incorporation of innovative tools and multimedia elements stands as a key avenue for refining AI tutoring platforms, ultimately contributing to a more personalized and effective learning experience.

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