ARTIFICIAL INTELLIGENCE BASED TUTOR

Karpagavalli R,

Asst Professor, Computer Science department,

Govt First Grade College, Hebbal , Bangalore

ABSTRACT The advent of Artificial intelligence (AI) has revolutionized various sector and education is no exception. This article combines artificial intelligence to promote research on teaching reform, which is aimed at encouraging the implementation of artificial intelligence education and promoting the development of cognitive and pedagogical skills.

Traditional education faces several challenges when compared to AI-based tutors. Here's a brief overview of some of these challenges, viz; limited personalization, time and resource constraints, lack of real-time feedback, limited access to expertise, lack of flexibility and adaptability & teacher workload.

AI based tutors leverage machine learning algorithms and natural language programming to analyse individual student needs and deliver tailored educational content and support. These tutors serve as virtual assistants, capable of adapting to each students learning style , pace and preferences. They provide individual attention to students, allowing students to access the content at their convenience, breaking down barriers of time and location.

It is important to note that while AI-based tutors offer potential solutions to some of the challenges in traditional education, they should not be seen as a complete replacement for human teachers. The ideal approach is to combine the strengths of AI with the expertise, guidance, and empathy of human educators to create a comprehensive and effective learning environment.

KEYWORDS*:* Artificial intelligence (AI), Neuro diversity, sensors, Natural Language Processing, Learning management system , Intelligent tutoring robots

I .INTRODUCTION

Artificial intelligence has rapid growth and is completely changing all aspects of life. It contributes towards learning and teaching methodologies too.
Literature study reveals the following; viz;

i. Student demand for flexible and convenient learning modalities is increasing.
ii. The focus on equitable and inclusive teaching and learning has expanded and intensified.
iii. The potential for AI to become mainstream is growing

Intelligent tutoring using AI holds great promise in revolutionizing education by offering personalized, adaptive, and engaging learning experiences. These systems can complement traditional classroom instruction and provide additional support for individual students, enhancing their learning outcomes

II. BENEFITS OF AI BASED TUTORS

By immersing students in technology from a young age, we are likely to be giving them a head start in the future workplace - where use of such technology will inevitably become more and more commonplace. Indeed, AI-based tutors have the potential to address several challenges in conventional teaching. Here are some specific ways AI is already bringing enormous benefits to learners:

i. Analyse Learning gaps: Specially designed AI platforms can analyse past performance, and identify learning gaps that can easily go otherwise undetected.

ii. Personalisation: AI can adapt content to the student, creating a personalised learning experience rather than a one- size fits all approach.

iii. Questions answered instantly: With the help of AI students can have their questions answered within seconds rather than waiting for a human response - this has the further advantage of encouraging shy students to ask questions without fear of being judged.

iv. Timely feedback & just-in-time learning: Students can also receive more frequent and timely feedback at the point of learning, when the topic is still fresh in mind and they are more open to learning.

v. Engagement: Learning with AI allows for gamification and other engaging learning environments such as VR and AR, which can greatly increase student motivation and engagement.

vi. Time saving: Using AI to help generate ideas or structure content frees up student time to focus on higher level skills such as analysis or creativity.

vii. Improved accessibility: With smart data gathering, custom tasks and personalised schedules, the boundaries between students, teachers and educational administrators can be bridged with the help of AI technologies. Barriers based on physical location, language, money can be overcome as we move closer to 24/7 access to all.

viii. Neuro diversity: Some neuro diverse students who may struggle with traditional settings or learning methods thrive in AI powered environments.

III. COMPONENTS OF AI BASED LEARNING

i. Virtual tutors and assistants. Instead of interacting with real tutors, learners can get explanations and help in real time using virtual tutoring and assistance. Traditional student assistance in the Learning management system (LMS) relies on a preset list of questions and answers. Adding AI capabilities helps an LMS understand unusual requests, provide answers that are more relevant to the questions, and create an experience close to communication with a real person.

ii. Interactive voice recognition. Voice assistance is particularly important for learning new languages, teaching people with writing and reading impediments, and teaching kids that can't write yet. To interact with such students, an LMS needs to be able to read the text aloud, recognize a student's speech, assess it, and respond.

iii. Personalized training sessions. The educational process is more efficient when it's adjusted to the needs and wants of a certain learner. While a traditional LMS provides some adjustment options when choosing a training course, AI makes this process more flexible and personalized.

iv. Attendance management. Monitoring student attendance at remote lectures takes time and effort. Some students may also cheat by attending only the start of an online class. One way to solve this issue is by proving attendance with biometric checks. But this solution is rather expensive, since all students will need some sort of biometric scanner. With a collection of student photos as a dataset, AI can detect students' faces in a video feed. It can also calculate attendance time, making it impossible for students to cheat. Such solutions are already widely used in 48,000 public schools in India.

v. Intelligent dashboards. Classifying and analyzing data gathered by an LMS can help you understand how users interact with it and find improvement opportunities. For example, you can create dashboards with students' performance, the most requested training courses, the average length of a training session, the most common questions and issues, etc.

vi. Assessment of learner engagement. The level of a learner's engagement may indicate issues with a training course, the poor quality of educational materials, issues with a tutor, etc. But this metric is particularly hard to assess in online education.

Deep learning algorithms can calculate engagement based on a learner's history of interactions with the LMS and educational content. They can also compare these interactions to the peer group, suggest reasons for changes in engagement, and propose improvements.

IV. INTELLIGENT TUTORING SYSTEMS

Intelligent tutoring systems (ITS) that utilize AI are designed to provide personalized and adaptive instruction to learners. These systems use AI algorithms and techniques to analyze student data, understand their learning needs, and deliver customized educational content. Here are some key aspects of intelligent tutoring using AI:

i. Personalized Learning: AI in intelligent tutoring systems can analyze individual student data, such as performance, preferences, and learning style, to provide personalized learning experiences. By understanding the strengths and weaknesses of each student, the system can deliver content and activities that align with their specific needs.

ii. Adaptive Instruction: Intelligent tutoring systems can adapt their instructional strategies based on real-time student performance. AI algorithms can monitor the learner's progress, identify areas of difficulty, and dynamically adjust the content and difficulty level to optimize learning. This adaptability helps ensure that students are appropriately challenged and engaged.

iii. Natural Language Processing: AI-powered intelligent tutors often leverage natural language processing (NLP) capabilities to interact with students using conversational interfaces. This allows learners to ask questions, seek clarification, or engage in dialogue, simulating the experience of interacting with a human tutor.

iv. Knowledge Tracing: AI algorithms can track a student's knowledge acquisition over time, identifying concepts they have mastered and areas where they require further support. This knowledge tracing enables the intelligent tutor to provide targeted feedback and interventions, tailoring the learning experience to the individual student's needs.

v. Data-Driven Insights: Intelligent tutoring systems generate vast amounts of data on student performance, interactions, and learning patterns. AI techniques, such as machine learning

and data mining, can analyze this data to provide valuable insights for educators. These insights can help identify common misconceptions, optimize instructional strategies, and improve the overall learning experience.

vi. Continuous Assessment and Feedback: Intelligent tutors can provide immediate feedback on student responses, allowing learners to correct mistakes and reinforce their understanding. The system can offer personalized recommendations for further practice or direct students to relevant learning resources to support their progress.

vii. Scalability and Accessibility: AI-powered intelligent tutoring systems have the potential to reach a wide range of learners, regardless of geographical location or time constraints. They can be accessed remotely and provide on-demand instruction, making education more accessible to diverse populations.

V. INTELLIGENT TUTORING ROBOTS

In order to fill up the gap between the education domain and artificial intelligence domain, this section first transforms the relationship model by describing the teaching-learning process, into the well-established perception-planning-action model in the area of AI.

Within each perception-planning-action loop, ITR percepts students' activities to collect information for analysis and planning, then reshapes the social and physical milieu for students learning, before starting a new round of perception. The next paragraph provides a brief overview of the specific design and mechanism for each module in the ITR and the rest of this section will be devoted to the detailed design of the perception, planning, and action modules. Intelligent tutoring robots architecture (ITR) is mentioned pictorially below;

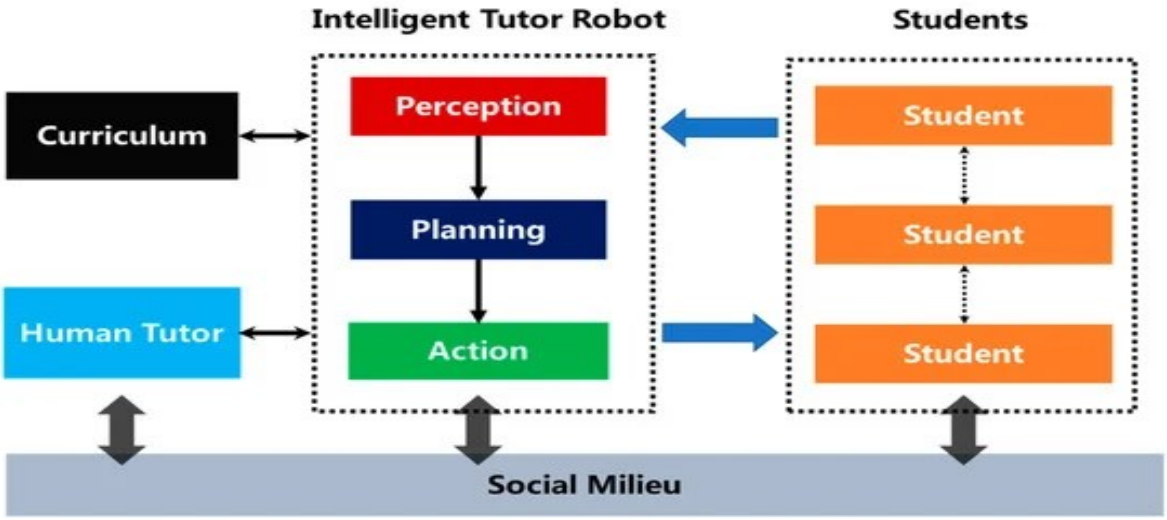

Fig1: Intelligent tutoring robot

The perception module adopts multi-modal sensors to observe students' activities and uses AI techniques for learning style and knowledge mastery analysis, which serves as the input for the planning module. The planning module builds internal models for students and evaluates teaching outcomes for different teaching strategies before making a decision. According to the teaching decision, the action module constructs teaching-learning scenes to generate appropriate social and physical milieus and uses multi-modal communication channels to deliver teaching contents. Continuous feedback enables the perception-planning-action loop to perform the online adaptation and endows the ITR to learn. Even so, due to the complexity and ethical issues of teaching pedagogy and knowledge structures of the curriculum, human tutors

may monitor and intervene in the perception-planning-action loop during either the designing or runtime processes.

V.1 Student Model and Teaching Outcome Prediction

This model includes the dimension of topics, misconceptions, affective characteristics, student experiences, and stereotypes, and may be instantly represented by operational student modules . Hence, the ITR may evaluate the outcome of potential teaching actions in its own "brain", before performing actions in the real world . Student Model and Teaching Outcome Prediction is mentioned pictorially below;

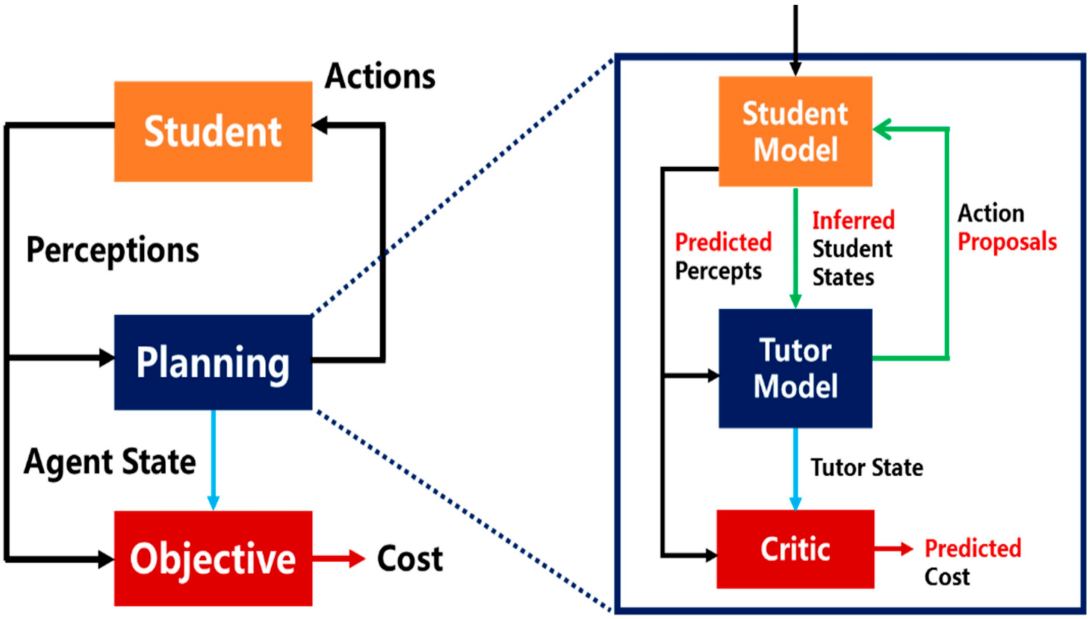

Fig2: Student Model and Teaching Outcome Prediction

V.2 Multi-Modal Perception of Students

For the human-tutor, the foundation of effective teaching that leads to student learning is to recognize an individual student's learning style and level of knowledge. As shown in Figure, the ITR may be equipped with visible light, acoustic, infrared, tactile, and other sensors. First, the ITR may utilize the multi-modal sensors to collect data of the external environments, from which the students' activities may be captured. Then, multi-modal data fusion is implemented to reduce the noise and interference in the data and align data from multi-modal channels. Then, the pre-processed data may be fed to a learning style analysis module and knowledge mastery module, which may apply AI techniques to extract useful information concerning the students learning status, learning styles, and the knowledge level. The Students and multi model perception is mentioned pictorially below;

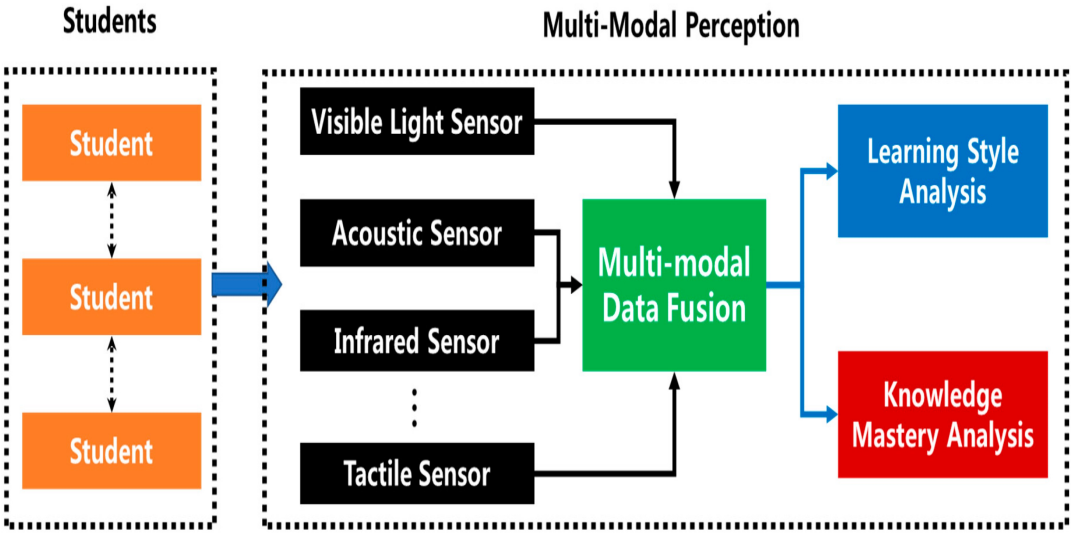

Fig3: Student & multi model perception

The first phase of initiating an effective cognitive perception-planning-action loop is to acquire sufficient information concerning the environments and the students. As shown in Figure, the ITR may use multi-modal perception by utilizing multiple information channels, e.g., audio, visual, tactile, electromagnetic, and electroencephalograph sensors. These sensors may outperform and augment human-tutor sensory capabilities. Pre-processing steps are demanded before extracting information from the raw signals. First, it is required to remove the noise and interference, while preserving the useful information. Then the signals and data gleaned from multiple independent channels should be aligned in the spatial-temporal space to avoid incorrect correlations.

In the context of the ITR design, multi-modal data fusion is not specifically explored, but the topic is well-investigated and stills a hot one in the context of data-mining and robotics. Due to space limitations, the rest of the section would not aim at a thorough review of the state-of-art data fusion. Instead, it reviews recent application driven surveys on data fusion and their great potential applications in the intelligent tutor design. Pixel-level data fusion is for multiple visual sensors with applications to remote sensing, medical diagnosis, surveillance, and photography.

VI. POTENTIAL CHALLENGES OF AI BASED TUTORS

While AI-based tutors have the potential to revolutionize education and provide personalized learning experiences, they also face several challenges. Here are some potential challenges of AI-based tutors:

i. Lack of Emotional Connection: AI tutors may struggle to establish an emotional connection with students.
ii. Limited Contextual Understanding: AI tutors primarily rely on data and algorithms to deliver instruction. However, they may struggle to understand the context and nuances of individual students, which can hinder their ability to tailor instruction to specific needs or address complex questions.
iii. Lack of Adaptability: While AI tutors can adapt their instruction based on students' responses, they may not possess the same level of adaptability as human tutors. Human teachers can dynamically adjust their teaching style, pace, and content based on non-

verbal cues, student engagement, and immediate feedback, which AI tutors may struggle to replicate effectively.

iv. Ethical Concerns: There are ethical concerns surrounding AI tutors, particularly in terms of privacy and data security. Collecting and analyzing student data for personalized instruction can raise privacy issues if not handled appropriately. Safeguarding student information and ensuring transparent data practices are crucial considerations for AI-based educational platforms.

v. Lack of Creativity and Critical Thinking: AI tutors typically excel at providing factual information and solving well-defined problems. However, they may lack the creativity and critical thinking skills necessary to engage students in open-ended discussions, encourage divergent thinking, and foster higher-order cognitive skills.

vi. Equity and Accessibility: Deploying AI tutors can exacerbate existing inequalities in access to quality education. Students without access to the necessary technology or reliable internet connections may be left behind.

It is important to address these challenges and find ways to combine the strengths of AI tutors with the expertise and empathy of human educators to create a well-rounded and effective learning experience for students. It is essential to consider these benefits and limitations when integrating AI-based tutors into educational settings. Striking the right balance between AI and human involvement can lead to a comprehensive and effective learning experience.

VII. Balancing Approaches to mitigate potential challenges:

To strike a balance, a hybrid learning model that combines AI-based tutors with traditional teaching methods is recommended.

i. Hybrid Learning Models: Implementing a hybrid learning model that combines AI-based tutors with traditional teaching methods can strike a balance. This approach allows for personalized instruction, immediate feedback, and adaptive learning while maintaining the benefits of human interaction and guidance.

ii. Teacher Training and Collaboration: Providing teachers with training and professional development opportunities to understand and effectively integrate AI-based tutors in the classroom is essential. Collaboration between teachers and AI systems can help optimize their use and ensure alignment with pedagogical goals.

iii. Ethical Frameworks and Guidelines: Developing ethical frameworks and guidelines for the use of AI-based tutors can help address concerns related to privacy, bias, and data security. These guidelines should be regularly updated and informed by input from educators, researchers, and other stakeholders.

iv. Regular Evaluation and Feedback: Continuous evaluation and feedback from teachers, students, and parents can help identify strengths, weaknesses, and potential risks of AI-based tutors. This feedback should inform improvements and modifications to ensure a balanced and effective implementation.

By adopting a balanced approach that combines the strengths of AI-based tutors with the expertise and guidance of human educators, we can harness the benefits of AI while addressing the potential threats and challenges associated with their use. This approach ensures that technology supports, rather than replaces, the essential role of teachers in education.

VIII. AI-based tutor useful for practitioners

There are several examples of AI-based tutors that have been developed to enhance learning experiences. Here are a few notable examples relevant to practitioners and researchers for upgradations:

i. Duolingo is a popular language-learning platform that utilizes AI algorithms to provide personalized language instruction. It adapts its lessons based on individual learner's strengths, weaknesses, and progress. It employs machine learning techniques to assess learners' proficiency, provide instant feedback, and optimize the learning path.
ii. Cognii is an AI tutor focused on providing feedback and assessment in the field of writing and critical thinking. It uses natural language processing (NLP) to analyze students' written responses, assess their comprehension, and provide detailed feedback on grammar, coherence, and critical thinking skills.
iii. SMART Learning Suite is an educational software suite that incorporates AI-powered tutoring capabilities. It offers interactive lessons, assessments, and adaptive learning experiences. The platform uses AI algorithms to analyze student responses and provide tailored feedback and recommendations for improvement.
iv. Thinkster Math is an AI-based math tutor that combines human coaching with adaptive technology. It offers personalized math programs and uses AI algorithms to analyze students' problem-solving approaches. Human tutors review the work, provide feedback, and adjust the curriculum to meet individual needs.
v. Carnegie Learning is an AI-based math tutor designed to support classroom teaching. It incorporates adaptive learning technology that adjusts the difficulty level and content based on students' performance. The platform provides personalized instruction, practice exercises, and assessments to help students improve their math skills.
vi. Knewton is an adaptive learning platform that uses AI algorithms to analyze student data and provide personalized recommendations. It offers adaptive assessments, content recommendations, and adaptive courseware in various subjects. The system continually adjusts the learning path to match the individual student's needs and learning style.

These are just a few examples of AI-based tutors that illustrate how artificial intelligence is being applied to enhance the learning experience. As technology continues to advance, we can expect further development and innovation in this field.

IX. EXECUTIVE SUMMARY:

Artificial intelligence has rapid growth and is completely changing all aspects of life. It contributes towards learning and teaching methodologies too It concludes that in life, teachers know more about common artificial intelligence products, such as sound aids , graphics, identity, fingerprint recognition, digital library, wikis, chatbots and smart classroom.

AI-based tutors are computer-based systems that utilize artificial intelligence techniques to provide personalized instruction and support in educational settings. These tutors have the potential to address various challenges in conventional teaching and enhance the learning experience for students.

The key benefits of AI-based tutors include personalized learning, immediate feedback, adaptive instruction, enhanced engagement, access to resources, continuous support, and data-driven insights. By analyzing student data and adapting to individual needs, AI tutors can tailor instruction, identify knowledge gaps, and provide targeted feedback, ultimately improving learning outcomes.

However, it is important to consider the limitations and potential threats associated with AI-based tutors. These include the risk of overreliance on technology, the challenge of establishing emotional connections, concerns regarding data privacy and security, issues of equity and accessibility, and ethical considerations related to bias in algorithms.

To strike a balance, a hybrid learning model that combines AI-based tutors with traditional teaching methods is recommended. This approach allows for personalized instruction and

adaptive learning while maintaining the benefits of human interaction and guidance. Teacher training, collaboration, and the development of ethical frameworks and guidelines are crucial in ensuring the effective and responsible use of AI-based tutors in education.

Further research and evaluation are needed to refine AI-based tutoring systems, address their limitations, and optimize their integration into educational settings. By harnessing the strengths of AI-based tutors while complementing them with human expertise, we can create a comprehensive and effective learning environment that meets the needs of diverse learners and prepares them for the challenges of the future.

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