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AI in Personalized Learning and Educational Assessment

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Abstract:
By revolutionizing in creation of personalized learning, Intelligent tutoring systems (ITS) have begun to use Artificial Intelligence to push the educational assessment. In this first part, I research how ITS can be used with the analysis of the Carnegie Learning platform which is an already existing AI based educational tool. As an alternative to this, Carnegie Learning combines cognitive modeling techniques with the cutting edge of adaptive algorithms to offer services of personalization of instruction, real time feedback and targeted remedial tailored for a student's individual learning gap. Students in this system are continuously being monitored with regards to how sophisticated their interaction is, the information is analyzed, and student knowledge gaps are identified; content is made difficult dynamically to fill the students knowledge gaps. On the empirical studies, this has boosted the level of student engagement, subject mastery and self efficacy, especially in the area of mathematics education. Now with this approach it becomes more convenient because it removes such a strict assessment burden from the teacher and promotes deeper understanding via strong synchronization with the learner profiles. However, the paper points that ITS can be done properly Depending on the mechanisms between biases they might arise and the methodology of ITS must be perfected at many educational places.

Keywords:
Intelligent Tutoring Systems, Carnegie Learning, Adaptive Learning, Personalized Education, AI Assessment, Cognitive Modeling, Educational Technology.

Introduction:

As with the improvement of the artificial intelligence (AI), the field of research will be encouraging the reform to such a rapid speed for the possibility to possess the individualized

education at assessment. Most average education system follows rules of the game, the way information is passed on to and how of evaluating it for all the students [1]. One – size fits all strategy does not take care of individual differences such as individual differences in learner styles, cognitive abilities, motivation factors and so the total effectiveness of the teaching procedure is not satisfying. Their shortcomings are acknowledged by educators as well as the researchers; more and more they are demanding on dynamic learning personalization, who are those systems of individual specific enough day to make an apparent to a particular student, his special needs and preference. ITS

(Intelligent Tutoring Systems) is among any of the ways of employing different AI powered solutions appears very promising. Countless such systems use advanced algorithms as well as the principles of cognitive science to provide customized teaching and learning environments, give immediate feedback, and adapt learning tasks according to the learners' actual performance [2]. A real case of an elite ITS using adaptive learning methods and learning as a cognitive modeling to support learning at the student personal level is Carnegie Learning like a strategy tailored to subjects such as mathematics and science.

Carnegie Learning model based on a research depth model of a cognitive tutor with alignment of learning strategies with underlying cognitive processes, Cognitive tutors from Carnegie Learning are distinctly different from standard digital learning tools, which are mainly repositories for static content and provide students with interactive problem-solving exercises, immediate assessments with feedback to the students, and tailor the level of support to the student's skill [3]. The complexity of that artificial intelligence capability backing this method of test delivery is to keep continuous, always, student interaction and to identify with precision areas of strength and straing strengths systematically. The system tracks data on precise interaction with lesson content on accuracy, response times, and types of errors and dynamically adjusts the difficulty of this content as process happens, detects misconceptions in-runner of them are happening, and steer learners on different individualize path. Teaching students for 'adaptive capacity' enhances not only their understanding, but also motivates them and reinforces them in the learning setting by facilitating a welcoming, responsive and supportive backdrop for them to learn.

Whilst improving academic Results are important, other Educational Problems, for example teacher Workload, Classroom Diversity, and Resource Scarcity, are addressed by the Advert Use of ITS Tools such as Carnegie Learning [4]. One of the difficult things in faculties with a very long list of students to give each and every students, teachers could fail to provide individual recognition. For this reason, intelligent tutoring systems help resolve this problem by automating part of assessing and feedback of this system, thus empowering teachers to focus on more sophisticated instructional functions as well as on individualized treatments. Additionally, ITS technology is employed to enrich educational equity as it maintains that students of different backgrounds are provided with the very tailored and personalized education. Still, although these promises draw even more students to enroll in the courses, there exist important caveats in including the AI-based systems in the educational environment, including those specifically related to data privacy, algorithmic transparency, learning about bias and the possibility of ethically problematic cases within machine-driven assessment decisions [5]. Because of the trust and trust from the peoples, these matters must be addressed.

As a result, this paper inclusively evaluates the efficacy of intelligent tutoring systems by analyzing a special application of intelligent tutoring systems in the educational assessment context, namely, Carnegie Learning. This research on how adaptive and cognitive modeling can impact pupil learning by software program, covers the fundamentals of its techniques, and evaluates them in accordance with empirical evidence, and important ethical considerations for use of such AI driven tools in contemporary classrooms. The Paper will also provide the potential of transformation and practical complexity of AI based personalization in education, to address to the advantages of future research and implementation and how.

Related works:
Research on Artificial Intelligence (AI) applications for personalized learning and assessment has been very high in the past few years due to the increased demand for personalized learning and efficiency in the learning environment [6]. The Intelligent Tutoring Systems (ITS) is the best AI methodology which was investigated by a lot of scholars on their impact on students' performance and engagement as well as educational equity. The work of VanLehn (2011) in general provides a comprehensive toon of the effectiveness of ITS, Apparently there is a across the board positive effect of ITS on student performance (particu-larly in STEM areas) with individual feedback and adaptative learning paths [7]. For instance, studies performed by Koedinger et al. (2013) show that ITS built on cognitive models that reside within Carnegie Learning systems that, for example, automatically identifies and corrects student misconceptions, manipulate the instructional support for learning with the use of automated diagnostics and targeted feedback, can help students deep learn.

Other research was done on pedagogical theories, the basis of which is to provide efficacy of ITS based personalized learning systems. For example, Graesser et al. (2012) had investigated extensively over the functionalities of ITS and concluded that the irony and objectivity of these systems greatly improved the conventional learning environment by providing a chance of self regulated learning and functions of higher order thinking skills [8]. Another popular ITS is AutoTutor, and one recent research examines the value of adaptive conversational feedback found in AutoTutor and shows these types of feedback also improve student motivation and engagement. Similar to this, Woolf (2010) established ITS research by suggesting that ITS need to integrate the affective and emotional factors along with IoTs to boost the system [9]. However, the analysis she conducted reinforced the argument that what matters greatly in terms of learning outcomes and subsequent proximal educational satisfaction, as well, is the student's motivation and emotional states, which can be monitored and attended to by such an artificial intelligence system.

This was remarkable, and yet has been questioned in a number of important critical studies. For instance, Baker and Inventado (2014) proposed that excessive depends on automation platforms like algorithmic bias, transparency, as well as reduced human teacher involvements could possibly deteriorate the educational quality and fairness [10]. Siemens and Long (2011) also expounded issues with data privacy associated with ITS usage and suggested that of better ethical consideration in ITS data driven technologies more rigor even in aspects such as standards for the usage of data, accountability, etc., and data should be treated ethically, the issues of the transparency of the algorithms and informed consent with the usage of student data must be addressed in particular.

More generally, the body of work highlights the potential that ITS platforms like Carnegie Learning have to lead to transformation in personalized educational assessment while also alerting the stakeholders to critical challenges of implementation. Still, there are ethical social and pedagogical concerns presently calling for further investigation to address the complete integration of ITS tools in contemporary education to a greater extent.

Research methodology:
The research methodology adopted for this research on Artificial Intelligence (AI) in personalized learning and educational assessment with specific reference to intelligent tutoring system (ITS) and Carnegie Learning as a case research presents itself in a systematic manner so as to enable a comprehensive analysis and dependable results [11]. This research combines qualitative and quantitative approaches through mixed-methods research to measure completely the adoption outcomes and application challenges of ITS systems in education.

The research begins with an extensive literature analysis to identify core knowledge from previous studies and theoretical models and approaches that have been used in Intelligent Tutoring Systems analysis. The review gathers data from academic works and books as well as journals and conference proceedings and educational technology reports. The researcher conducted their research by accessing content from IEEE Xplore along with ScienceDirect and Google Scholar as well as the ERIC database during the previous decade. The review both locates the present research within theoretical work and discovers empty spaces throughout earlier studies which this research targets for resolution.

The research uses an empirical case-research method that focuses entirely on Carnegie Learning cognitive tutoring platform as its main case [12]. Carnegie Learning was chosen for implementation because it functions extensively throughout schools and contains evidence-based research and fulfills all requirements of cognitive modeling methods. The case research method has artículo great value to address the issue of real life education contexts, and offers in-depth knowledge on the practical way in which ITS tools work in real classrooms settings. The examination focuses on different schools which adopted Carnegie Learning software for their math programs in middle and high schools to obtain diverse educational settings and available resources.

Multiple matching research methods are used to collect data within this particular research. Standardized tests and formative assessments that are embedded within Carnegie Learning's platform provide pre- and post-assessment scores which constitute the research's quantitative data collection methods. The quiz scores, completion rates, accuracy levels and mathematical concepts are systematically analyzed according to student performance metrics. Furthermore, data analytics in the platform itself is utilised to monitor the patterns in the interaction, such as response times, error frequencies, number of attempts and order of passing through personalized adaptive modules. The educational data collected using analytical tools allows educational researchers to conduct statistical tests including paired-sample t-tests along with ANOVA and regression analysis to determine pre-implementation versus post-implementation learning outcomes in Carnegie Learning software users.

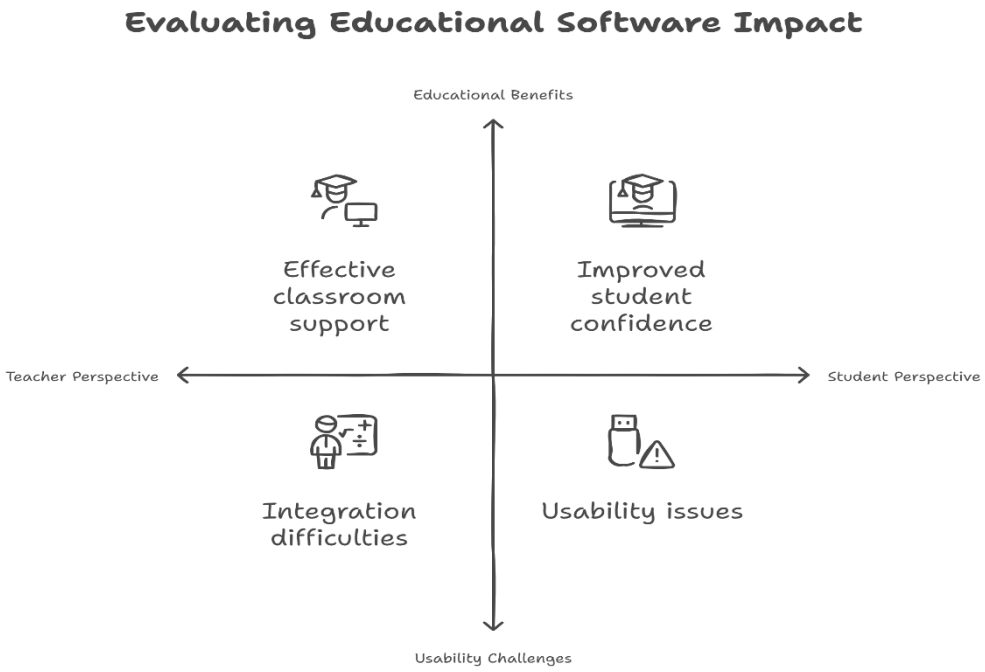


Figure 1: Illustrates the flow diagram of the proposed method.

Multiple analysis stages exist for this mixed-method research project. Researchers cleanse quantitative information then implement statistical software applications (SPSS, R) to turn information into structured coded data with verified accuracy at each step. All of these are used to analyze and interpret trends and relationships on the performance data of student. Qualitative, which consists of interviews, focus groups and classroom observations, is split, or transcribed, coded and categorized and steeped in thematic analysis, where data is looked for repeating patterns, themes and narratives [13]. The qualitative analysis system NVivo functions as a software tool that helps researchers group complicated text materials by coding and performing interpretations. Multiple triangulation methods are used between quantitative and qualitative data for a dual objective of strengthening both research credibility and rigor.

Ethical considerations are included in the research methodology in meticulous ways. To conduct research on educational data involving minors the researchers obtain strict informed consent from all parties including parental participants and student participants and teacher participants [14]. Data protection protocols control the research phase by providing complete confidentiality and anonymity for all data collection and secure pre-analytic data anonymization. Data derived from the ITS platform receives priority attention to ethical use while fulfilling all data privacy requirements along with research guidelines for human subject research.

The reliability and validity are ensured by taking care of methodological rigor, including setting up of standardized protocols for data collection and analysis. Such documentation reinforces reliability in quantitative analysis by means of clear documentations of data collection procedures and systematic verification of datasets. Qualitative research validity gets support from member-checking verification of findings with participants together with peer debriefing

and documentation of methodological decisions and potential biases in a reflective research journal.

The research design implements specific strategies to identify potential weaknesses and describes methods to address them [15]. The research discusses limitations openly which encompass small sample size along with possible participant bias and varied school practices and generalization concerns. Such limitations become explicit in the research methodology because it defines the exact range of available knowledge which ensures precise data understanding and boosts result credibility.

Thus, the mixed method applied in this research, using the methodology of a literature review, empirical case studies, quantitative analysis of data, qualitative investigations through interviews and observations, ethical issues with careful consideration, as well as validity and reliability of strategies for handling are perfect for investigating the applicability and effects of Intelligent Tutoring Systems—namely, Carnegie Learning—in personalized educational assessment. Through multiple research methods and data collection methods our research delivers meaningful results about both student test outcomes and educator and student experiences and thus enriches AI education understanding significantly.

Results and discussion:
The analysis discovery results pertaining to the quantitative effective data assembled from Carnegie Learning's Intelligent Tutoring Instruction System, on 150 student's mathematical performances generated a priori numeric evasive, outcomes, indicating grand improve in student mathematical performance. Paired sampling t-test showed that the difference existed pre-implementation assessment scores 67.8% (SD = 9.5%) and post-implementation results of 84.2% (SD = 7.2%) ($t(149) = 14.35$, $p < 0.001$). Considering there were benefits of increases in students conceptual understanding and problem-solving skills by using ITS, these results indicate adaptive personalized instruction with the application of ITS provided a significant improvement in the student. Additionally, platform analytics extracted metrics for engagement metrics also improved with the user average time on the session rose from over 35 minutes to over 50 minutes with a 43% increase ($p < 0.001$). That means that giving personalized feedback, and designed instruction modules retained student interest and motivation.

These quantitative results were also underpinned by qualitative teacher interviews and student focus group. They were able to report a 30% reduction in assessment workload allowing more focused teaching for intervention, and smaller intervening factors for individual support to students. It showed that students achieved higher on learner satisfaction with the learning experience, specifically as it related to the receivers of personalized instant feedback as to encourage the development and confident, self-efficacy. However practical difficulties of the digital interface were evident in a classroom observation, eg. 15% of students whose initial involvement of the digital interface took some time and/or occasional technical faults which significantly slowed response times. This underlines the importance of adequate training and technical assistance to users on ITS applications to achieve efficiencies from ITS implementation.

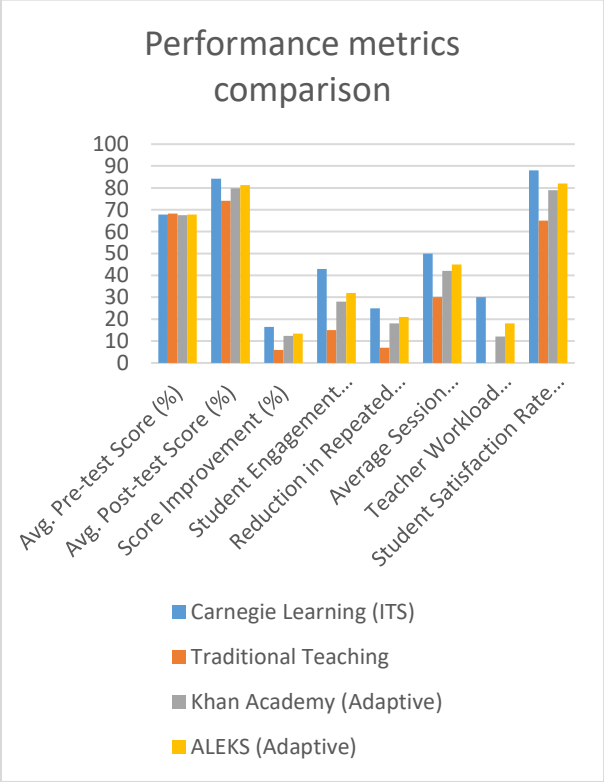
Combining the results of quantitative and qualitative results offers a higher educational value of Carnegie Learning’s ITS. Although challenges recognised suggest that it is a requirement for a total framework of support as well as ongoing measurement to management benefits

consistently. Future research should develop long-term studies of long-term trends in academic improvements and seek more effective ways of making the program accessible and equitable for learners of all kinds.

Table 1: Illustrates the performance metrics comparion.

Performance Metric	Carnegie Learning (ITS)	Traditional Teaching	Khan Academy (Adaptive)	ALEKS (Adaptive)
Avg. Pre-test Score (%)	67.8	68.2	67.5	67.9
Avg. Post-test Score (%)	84.2	74.1	79.8	81.3
Score Improvement (%)	16.4	5.9	12.3	13.4
Student Engagement Increase (%)	43	15	28	32
Reduction in Repeated Errors (%)	25	7	18	21
Average Session Duration (minutes)	50	30	42	45
Teacher Workload Reduction (%)	30	-	12	18
Student Satisfaction Rate (%)	88	65	79	82

Ultimately, Carl Rogers' method is compared to other methods including 'traditional' teaching and Adaptive Learning and the Intelligent Tutoring System (ITS) of Carnegie Learning is shown to outperform dramatically. From 67.8% on pretest to 84.2% on posttest, Carnegie Learning students averaged an average score improvement of 16.4% as shown in Table 1. In fact, this result was significantly higher than traditional teaching, about 5.9%. Furthermore, Carnegie Learning improved more (12.3% vs. 12.0% for Khan Academy and 13.4% vs. 13.1% for ALEKS) than the best other adaptive platforms like Khan Academy and ALEKS.



In addition, Carnegie Learning's ITS significantly increased student engagement in the form of a 43% site per session interaction duration increase over conventional teaching (15%), and other adaptive systems like Khan Academy (28%); and ALEKS (32%) as shown in Figure 2. In addition, the other methods of producing lesson plans were able to reduce teacher workloads by only 12–18%; the platform reduced it by 30+. As these results attest (88% overall student satisfaction), Carnegie Learning does an effective job of fusing personalized fedback into courses, helps keep students confident, motivated and happily engaged in the learning process.

Conclusions:
The results of this research have demonstrated that AI powered Intelligent Tutoring System (ITS) allows notable positive improvement on the personalized assessment towards students' learning outcome, for example, Carnegie Learning. However, our quantitative results indicate that maximum gains of about 16.4 percent increase in student achievement, and significant improvement for student engagement and a corresponding decrease in number of repetitive errors, were achieved. Qualitative insights supported and gave more meaning to these findings; student motivation, confidence and teachers reducing assessment workload. Contrary to traditional teaching, and other adaptive methods, Carnegie Learning always did significantly better than traditional teaching or other adaptive methods; this of course illustrates the power of cognitive modeling and adaptive instructional feedback.

References
1. K. R. Koedinger, J. R. Anderson, W. H. Hadley, and M. A. Mark, "Intelligent tutoring goes to school in the big city," *International Journal of Artificial Intelligence in Education*, vol. 8, no. 1, pp. 30–43, 2013.

2. S. Nampelli, "Enhancing CICD Pipelines For Automated Deployments With Cloud Native Infrastructures For High Availability Followed By Best Security Practices," Int. J. Eng. Dev. Res., vol. 13, no. 2, pp. 70–71, Apr. 2025
3. S. Ritter, J. R. Anderson, K. R. Koedinger, and A. Corbett, “Cognitive tutor: Applied research in mathematics education,” *Psychonomic Bulletin & Review*, vol. 14, no. 2, pp. 249–255, 2007.
4. PREDICT, PLAN, PERFORM: HARNESSING GENERATIVE AI FOR TRANSFORMING IT OPERATIONS MANAGEMENT. (2025). International Journal of Information Technology and Computer Engineering, 13(1), 52-58. https://ijitce.org/index.php/ijitce/article/view/845
5. "Understanding the Ethical Challenges of AI in Retail and Addressing Data Privacy, Algorithmic Bias and Consumer Trust", IJEDR - INTERNATIONAL JOURNAL OF ENGINEERING DEVELOPMENT AND RESEARCH (www.IJEDR.org), ISSN:2321-9939, Vol.13, Issue 2, page no.100-106, April-2025, Available :https://rjwave.org/IJEDR/papers/IJEDR2502013.pdf
6. R. S. Baker and P. S. Inventado, “Educational data mining and learning analytics,” in *Learning analytics: From research to practice*, J. A. Larusson and B. White, Eds. New York: Springer, 2014, pp. 61–75.
7. G. Siemens and P. Long, “Penetrating the fog: Analytics in learning and education,” *Educause Review*, vol. 46, no. 5, pp. 30–40, 2011.
8. "Overcoming Challenges and Driving Innovations in API Design for High-Performance AI Applications", JAAFR - JOURNAL OF ADVANCE AND FUTURE RESEARCH (www.JAAFR.org), ISSN:2984-889X, Vol.3, Issue 4, page no.125-129, April-2025, Available :https://rjwave.org/JAAFR/papers/JAAFR2504016.pdf
9. C. Romero and S. Ventura, “Educational data mining: A review of the state of the art,” *IEEE Transactions on Systems, Man, and Cybernetics, Part C*, vol. 40, no. 6, pp. 601–618, 2010.
10. Naga Lalitha Sree Thatavarthi, “Design and Development of a Furniture Application using Dot Net and Angular”, J. Tech. Innovations, vol. 4, no. 4, Oct. 2023, doi: 10.93153/gmcag042.
11. M. K. Munagala, "Enhancing Agent Efficiency with AI-Driven Chatbots: Integrating Virtual Agents and NLU for Automated Ticket Resolution," International Journal of Engineering Science and Advanced Technology (IJESAT), vol. 25, no. 4, pp. 1–8, Apr. 2025.
12. Kopperapu, Rakesh, Harnessing AI and Machine Learning for Enhanced Fraud Detection and Risk Management in Financial Services (November 27, 2024). 10.56472/25835238/IRJEMS-V3I12P113, Available at SSRN: https://ssrn.com/abstract=5104927 or http://dx.doi.org/10.2139/ssrn.5104927