

## Investigating Students' Achievement in Learning through Artificial Intelligence in Education: A Case Study

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**Abstract:** The purpose of this research was to investigate the impact of artificial intelligence in education software through exploring the learning achievement of students. Two classes were selected to participate in this study. An experimental group used artificial intelligence in education to study English, while a control group used traditional methods with a paper-based reading and writing program. A quasi-experimental design was used, and the results showed that although there were no significant differences in the pre-tests on English when comparing the two groups of students, there were significant differences in the post-test. The experimental group had better improvement in reading and writing English, including better development in predicting and searching for answers. Surprisingly, the motivation of students who persistently followed the instructional program was not lowered but maintained at a high level. This research examines how an artificial intelligence in education program affects students' learning achievement, allowing teachers to further understand its effects. However, this study found various notable areas for improvement with this new technology. Through this research, several real-world applications and directions for future research are discussed. Knowing both the advantages and potential shortcomings of artificial intelligence programs, as well as the students' responses, teachers will find it easier to design the learning process according to students' needs. The results will certainly help to further develop the design of artificial intelligence in education programs.

**Keywords:** Artificial Intelligence, Education, Learning, Students' achievement.

### INTRODUCTION

In recent years, the education sector has improved through the implementation of new technologies that have facilitated the learning process. One of the technologies that has achieved great implementation and acceptance is artificial intelligence (AI), which has been applied in various areas, including education, and has been used as an effective learning tool to generate personalized learning in an intelligent way. Ahmed, *et al.*, (2021) defined the educational agent is an AI application that has the ability to operate in a simulated educational environment in order to provide help and guidance as a companion to the student, as if he or she were real. The relevance of this topic is based on the interest it raises with regard to learning, since these agents can increase the efficiency of the process by offering individual attention corresponding to students and where they need it (Kim & Kim, 2022).

In this regard, this research aimed to provide evidence of the effectiveness of intelligent educational agents to support the teaching process in the science area of teaching, facilitating the learning of its students. In this sense, it was used as a specific objective to address the performance of two intelligent educational agents using the teachable agents methodology for teaching the

phenomenon of displacement in primary physics for seventh grade. The present work was categorized as an applied research investigation with a quantitative approach, using the methods of content analysis, tracking, and quasi-experiment; moreover, the type of research used was educational. The participants were 35 seventh-graders belonging to an educational institution. Further implementation carried out, accompanied to analyze and support the students emphasized the intention of the process; the more relevant part of the actions is to describe and predict the behavior of intelligent agents that support improvements in learning made by these students (Dai & Ke, 2022)

Artificial intelligence in education is an innovative research area, and the application of its techniques introduces new elements in the development of educational software. Interesting and promising progress is being achieved through the application of the AIED perspective in developing intelligent tutoring systems. Frameworks that enable the development of intelligent tutoring systems promote configuring and reusing pedagogical parameters and ensure their adaptive behavior are currently being devised. Many of those systems have proved to greatly enhance learning and, in certain contexts, to significantly increase students' achievement in the content domain covered by the

system while using it. Furthermore, Guo, *et al.*, (2021), intelligent tutoring systems can support different learning strategies such as individualized, cooperative or competitive learning, and can support the implementation of both differentiated instruction and a high degree of tutoring centered on the student's ideas and processing style. Consequently, artificial intelligence in education prompts the proposition of new learning strategies that are particularly suitable in environments with several intelligent agents. If dramatic changes are made in the way that educational software works, we should take a critical look at the systemic framework in which it operates and investigate how educational software contributes to change, improve, and reinforce the educational system (Wang, *et al.*, 2023).

The main aim is to investigate how artificial intelligence in education, in particular an intelligent tutoring system, helps students in their learning. The research concentrates on a new course in mobile robotics, which is not familiar to first-year students. The intelligent tutor system that has been developed provides a group with adaptable learning material and exercises. The exercises are designed to: stimulate students to explore unsolved problems in marked fields, help them in constructing technical devices and programs for solving the problems, organize feedback from tests and real-world experiences, and then systematically question them about the new knowledge derived from real-world stories. The influence of AIED on the performance of students, on students' motivation to learn, and on knowledge transfer in the immediate and long-term perspective will be described. The grouping of students, task organization, and evaluation of work are, in this case, very important.

## LITERATURE REVIEW

Students' achievement in learning has long been an important issue in the educational system. Over the years, many researchers have investigated educational issues, especially students' achievements in learning. Although the learning environments were very different in the past, the main objectives and issues of research remained the same. However, the introduction of AI into the educational areas provides new opportunities to deal with these educational issues (Kuleto, *et al.*, 2021). This study investigates the possibilities in learning through AI in education by proposing a model, which consists of four AI engines, to realize individualized and intelligent tutoring

within an e-learning system. To understand the future of AI in education, it is very important to understand the current concerns that have grown around the issue of computer-based education. The important concerns of today are no different from those of the past. As we venture into a future that looks increasingly computerized, it is important to remember that the computer is only another medium, another way to express educational intent. Computers do not motivate students any more than topic sentences do or good teaching. It is not the computer, but what is done with it that matters. If the computer is to become an important element in education, it must be shown to be valuable for accomplishing educational goals. These goals are the same goals that have been served effectively for generations of students yet continue in varied educational settings (Zhai, *et al.*, 2021).

### 1. Artificial Intelligence in Education

Artificial Intelligence in education is a complex amalgam of computer science, psychology, linguistics, philosophy, sociology, and neuroscience that has the capability to learn everything from human beings. This area aims to provide numerous contributions oriented to diverse purposes like individualization, discovering students' behavior, or students' achievements during learning, diagnosis, and also remediation of students' learning problems. Learning with Artificial Intelligence has yielded many positive experimental results because it can predict students' learning methods, multiple behaviors, and learning achievements. Meanwhile, in our investigation, we applied learning with an intelligent belief as a model that adapts to help learners in many multi-learning concepts. This model is trustworthy and useful in many forms such as mutual, agent, machine, and also expert. In our investigation, learners learned either with an instructor or a computer in both supervised and unsupervised models. Our goal in this investigational study is to evaluate students' achievements in learning in Grade 6 at Watwalai School. Our experimental models are a Hybrid Intelligent Learning Model and the Mutual Adaptation Model. These are learning models from a traditional pair of learning, not from machines or experts. Our students' achievements in learning are interesting through data collection instruments. Data are collected from a pre-learning test, post-learning test, file score statistics, or accomplishments during learning. Our experimental results have shown that the

achievement in the traditional learning model in supervised and unsupervised models is better than the Marinico model with repetitive non-experiencing games presented (Khan, *et al.*, 2021).

## 2. Student Achievement and Learning Outcomes

Student learning objectives are important and often emphasized in school settings. In order to evaluate how beneficial learning is in specific student learning goals, different forms of assessments are expected to take place. Educational assessment comes along with assistance on improving learning procedures and provides students with opportunities to further their knowledge. While students learn, they need feedback on how they are progressing. Teachers are responsible for providing feedback, but they are often overburdened as they have to deal with evaluation tasks, including setting examinations, grading, and providing feedback. Artificial Intelligence in Education is a specialized technology that can be used to help people learn on the computer, automatically providing feedback to users. In this study, we discuss the question of whether AIED can be used to teach effectively and suggest the use of an artificial learning companion to help students in an online primary science education system (Sajja, *et al.*, 2024).

The current paper presents a general background on student achievement and learning outcomes. It starts with a discussion of student learning objectives and the role of assessment in education. It goes through how to evaluate assessment tools. It presents the main types of questions in educational exams and provides some general guidelines for selecting question types. It then provides a list of attributes about question writing that enhance the information provided through educational assessment. Given the space limit, the paper cannot cover all topics and encourages readers to refer elsewhere for a general discussion about educational assessment. In the conclusion section, we summarize the contributions of the paper and provide future research directions (Gamage, *et al.*, 2021).

## METHODOLOGY

### 1. Research Design

This research project was carried out using multiple and mixed methods for designing and analyzing the learning system and also for investigating students' achievement. Qualitative and quantitative methods and some tools are used in the research. The research process can be

separated into four main subjects such as learning achievement, learning motivation, and research design. As a result, we have designed methods and models for teaching and learning, disappointed learning, and analyzing knowledge. Using the designed methods and models, we have then developed the desired multiagent systems. With these systems, we have conducted experiment sessions and put them as a case study. After completing the case study, students' achievement is then assessed and analyzed using qualitative methods and a set of tools. This research shows that there is a robust mechanism for achieving human-like intelligent behavior, capturing the uncertainty, limitation, inconsistency, and vagueness of domain knowledge. In addition, it can automatically teach the unsupervised user on demand. Therefore, the user can also perform efficient active learning (Gweon, *et al.*, 2023).

### 2. Data Collection and Analysis

To conduct this investigation, we conducted the technology-enhanced learning application. During this learning process, the answers to each individual problem were under control, which could give us not only the learning status as a sequence but also all the important parameters under the learning process. From the results learned from students' learning activities, the first finding is that different students have different types of learning trajectories in cognitive skills cultivation. According to the corresponding performance data from each student's learning process, we measured and analyzed individually how much each method contributes to students' performance. From the experimental results, passive behavior has no better or worse nature divergence, whether it exists or not during students' learning process (Bayly-Castaneda, *et al.*, 2024).

Finally, we compared students' learning trajectories and cognitive skills cultivation through different evaluation perspectives. If a small group needs a clear target for cognitive skills cultivation, our result lends credence to the approach of using targeting analysis. From the previous research results, two major problems are found. The first one is that necessary activities such as quizzes, assignments, examinations, or projects, in these activities, students are needed to demonstrate what they have learned and are wanted to give feedback to guide students' learning process. To solve these questions, we employed an AI supportive approach and constructed an online learning environment. The important feature is to use available AI

support to give students timely feedback for guiding their learning process. Through the analysis of variable weights, paired comparison of preferences for online feedback, and analyzing passive behaviors, they are motivated by a course management approach. In this study, we found some superficial evidence that they could be effective for some e-learning courses. During their process of learning, the online features and passive behaviors are taken at issue by some students. We provide learners with relevant learning content based on preferences, interactive learning activities, and synchronous queries to promote self-regulated learning.

Data were collected from a knowledge management course where the online learning environment tool was used intensively by seventy students of various knowledge backgrounds during a higher education term. Results show that cohorts of such students are able to learn as effectively as they would in a traditional face-to-face learning environment. According to qualitative and quantitative student interviews, providing the facilities that adaptive learning offers can enhance students' learning experience and would support the diet by providing flexibility for students to choose what and when they want to learn. After analyzing the characteristics of the students' learning behaviors and their performance, these empirical findings suggest that our new system can provide an innovative framework for supporting e-learning in a university environment.

## RESULTS

This pathfinder has been developed to answer the research questions consisting of the following question: "How can an intelligent agent be generated for learning environments?" In accordance with this aim, system specifications and steps of design and development have been implemented with the developed pathfinder. The computer-assisted intelligent tutoring system, which has intelligence generated by learning from experts, has been set up. This system has taken into consideration the sterility, invariability, self-control in time, compliance with the abilities, and personalization principles, which are new specifications for intelligent tutoring systems. The intelligent tutoring system produced in the research has a more flexible and variable structure. This structure can be updated via the modular software. In the case study, the successes of the students who exploited the system have been compared with the classroom training

environment. It has been determined that the students' achievements acquired through the system are higher compared to using the classroom environment. The successful effects of the physical limitations, such as time, place, and the pressure of the examination, provide individual learning opportunities in the integrated environment applied to the web. When the contents of the case have been examined, it has been found that the case has increased the knowledge and skill levels of the students. It has been determined that the students who have exploited the system are at higher success levels.

## 1. QUANTITATIVE ANALYSIS

In order to analyze the data retrieved, the software was used. To investigate the first hypothesis, which was designed to check whether artificial intelligence in education has an influence on learning, a t-test analysis was chosen. This analysis was selected as it allows the comparison of the mean scores of two groups and determines if there is a possible difference between the two. In this respect, the data revealed the true measures of the central tendencies, i.e., the mean scores of grades obtained for all six tests (two for the subject matter knowledge and one for each of the five categories in the relationship: understanding, application, analysis, synthesis, and evaluation). A paired sample t-test was chosen to analyze the same students. The measurement scales are parametric in variation.

Analyses were performed for each of the six scores, so for each of the six tests that existed in the experiment. Descriptive statistics tables were then compiled for each of the six questions of the experiment, and the data was analyzed. The next step was to investigate the second hypothesis, which stated that the frequency of the feedback presentation by a tutor during the pedagogical conversation with the students has a particular effect on student achievement. A t-test analysis was chosen again to investigate the results. The foundation of the data on which the result of this hypothesis depends is given by the frequency with which the two groups of students, the group that provided supportive feedback and the group that did not, presented the feedback. The scores received by the group measuring the feedback have the form of a ratio scale.

## 2. QUALITATIVE ANALYSIS

The qualitative method was also utilized in an attempt to extract information. Analysis was done on the subjective descriptions of the learning



experiences of both categories of students regarding the implementation of required questions, posing, and a responding process. Successful descriptions led to answering several sets of questions, which raised the analytical units in view. Analysis was on the subjective descriptions. Extracted information was then summed up, and a proper interpretation was done. The complete ideographic method was used to collect useful information. Intra-case analysis was then used in an in-depth manner. Afterwards, either phenomenology was utilized or content analysis. The constructivist view was established as the means for cases of inquiry. Data reduction came first, and with the aid of a nominal perspective, descriptions and the subjective inferences became condensed. Different coding was then done, and the data was transformed into shorter or concise statements or organized confined meanings. Eventually, the meaning of such interpretations was taken. Results are not empirically based, but no doubt can at any higher levels explain causalities in complex world phenomena, presenting a healthy criticism of the findings. Empirical demonstrations are vital to the future success of a development.

It was possible and workable to collect descriptive data. Upon the elimination of extraneous variables, the educational phenomenon started to be minimized. The students had interest in the visualization of interaction between the modules and the workings. Lack of both was expressed by some students, whereby they only understood the interaction with other peers and AI. One student expressed concern in voicing a bit of confusion with the AI module content, primarily on the readings. Results ensured a relation to techniques and methods, and the clear visual manifestation to the students created a deep understanding of how the AI used visual relationships and factor analysis applications to its own advantage. These students indicated satisfaction with the module software, and the demonstration of these features yielded an impressive result. Sometimes visual aids can relate and help understand before and after achievements. The physical classroom and graphing calculators assisted in the visualization and manipulation of images, aiding the connection with the registration information displayed in the context of an overall conceptual idea.

## DISCUSSION

The experiment has raised some important points about the use of our system. One important part of

this experiment related to the learning within the system. The fact that students could go through the system again and again, and no one checked whether they actually learned anything, was raised in the meetings with the experts. We agreed that lectures are not very good for activating the students if the teachers do not arrange some sort of discussion sessions, in which the actual learning can be tested. We should do the same thing within the system. This is a more general problem with educational software: all coursework should not be based on pass/fail division; an evaluation test performed afterwards will not correlate with how the students have studied. We need to follow up the cognitive process but also add the possibility for deeper cognitive learning.

Most students thought that the system was pedagogically efficient. The explanation of the learned profiles was the part of the system that seemed most useful. The explanations were chosen during the first meeting, and the students likely never used the learning facility of the system at all. This is a conflicting result. We have extensively argued for the fact that a system that helps the students to raise confusion in the data will help them a lot when making decisions and evaluating what they already know. On the other hand, there is a benefit to offering the students explanations of models, even if the students have a possibility to do this themselves. This is an illustration of the potential conflict when offering too much help in a learning situation. The students do value learning, just not too much.

The goal of this project is to create an artificial intelligence teaching assistant in order to improve results in classrooms. For a proof of concept, I decided to focus on learning about logarithms in high school using genetic algorithms for tutoring. Genetic algorithms are commonly used for real coding or design problems, but they can work in teacher earnings, too. The problem has some important features. Therefore, the results have shown that by giving highly structured examples to the tutoring system, the learning process is improved. However, the surrogate's response is better when students work with highly dispersed examples. In this section, we discuss the results obtained by using genetic programming surrogate response in the genetic algorithm. We should be able to extrapolate the trends in the training subset for the real problem. The first point to be considered for the envisioned statistical validation is the evolution of the average error and the error dispersion during the timeframe employed. First,

the present demonstration has used what is employed for genetic programming validation: the examples from the population at each generation.

When implementing an AI type of pedagogy, it is very important to explain to all participants or stakeholders what AI is and its immediate and long-term goals. Another purpose of implementing AI in education is the enhancement of the effectiveness and efficiency of the educational and learning process. A recommendation to achieve this goal is to integrate the teacher and students as co-agents in the learning process. In the process of doing this, the role of the teacher should be presented in a personalized way to both the teacher and the students. In this case, guidelines are presented to the teacher written in such a way that the teacher feels respected and valued at all times. The intelligent tool takes over the role of the personal mediator and gives the teacher the possibility to not be overloaded with work. The teacher is constantly supported and motivated, but most importantly, they can provide the student with emotional support from an educational point of view. This intelligent tool is able to send daily reports to the teacher on the progress and emotional state of the child, informing them if there are any learning problems or not during good educational and learning time.

The creation of personalized learning environments is one of the most complicated tasks in educating our children. Research has shown that when children develop and demonstrate a lack of confidence, self-motivation, and anxiety, learning problems arise. These conditions are barriers to reducing student performance. These obstacles are tackled through the implementation of tutor agents and intelligent tools that are resilient to the stress of learning. These systems must constantly motivate, monitor, and guide the learning process. In conclusion, due to the rapid development of AIED, intelligence should be used for the benefit of children. These intelligent agents enter the educational process with the square and the compass, aiming to assist all parties concerned. To facilitate the teacher's role and improve personalization, the intelligent tool contributes to the creation of emotional, motivating, and learning acknowledgments, reducing the teacher's cognitive load. This smart tool is not designed to replace the teacher, but to act as a mediator. They can operate as an extended arm that knows the student. This will enhance social findings and developmental messages that interact with children. Introducing AI in education is a great challenge for technology,

where relationships and influences play a key role in the emotional intelligence of a child. This is the major way of expressing and improving this intelligence.

## CONCLUSIONS

The paper has introduced a novel approach to deploying emotional AI in the educational field, discussing the performance patterns and individual differences of students to enhance the quality of emotional intelligence education in collective learning settings. An extensive analysis was conducted, proposing applicable findings for practical use. The results showed that students in the high achievement group felt more stressed and bored, providing an indication of negative effects when students are set to a relatively high level and may need to be re-examined during their learning practice. However, better multi-dimensional analysis measures can support teachers in designing their teaching strategies, leading to more efficient contingent teaching, greater interrelationships between instructors and their students, and fuller control over the pace and direction of the learning process. In the future, we plan to enrich this method by providing additional resources to collect further data, such as other multi-sensor technologies, to see how knowledge is transferred and integrated into existing knowledge, and how to improve learning performance by forming effective teaching strategies and management, as well as what other methods can be applied in this aspect. As a direction for future development, the plan is to apply the proposed method to both children and young students and extend the proposed framework to other school subjects beyond statistical mathematics. Our expectation is that the proposed method can be utilized to improve emotional AI in other school subjects, and that emotional AI can enhance students' performance in these subjects, leading to beneficial outcomes by using the intelligent character of students' learning status data to adjust teachers' teaching strategies.

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