
Integration of Artificial Intelligence as a Co-Teacher to Enhance Student Engagement in Primary Classrooms: A Case Study of District Khyber, Pakistan

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DOI: <https://doi.org/10.70670/sra.v3i4.1432>

Abstract

This paper has explored the possibility of artificial intelligence being utilized as a good teaching tool in the Khyber district in the primary schools of Pakistan. The main goal was to discover the influence of AI-supported co-teaching on student engagement and their learning outcomes. The combination of approaches involved questionnaires, observations in the classroom, and online educational resources.

Data was taken at the pre-intervention stage and at the end of the twelve weeks educational intervention.

The outcome implied that the three aspects involving the students, namely: emotions, behaviors and cognitive abilities increased significantly. Students were more dynamic and attentive in the classroom; they showed more interest in the subject being taught and comprehended it. Without much enthusiasm, the classroom activities were no longer attended and the cases of distraction in classroom activities minimized to a large scale. Such outcomes were backed by excellent statistical tests.

The academic performance was also improved during the time of intervention particularly in science, mathematics and Language. The use of AI products assisted students by enabling them to pay more attention and teachers by making their explanations and response time more precise.

According to the research, artificial intelligence (AI) has the ability to improve the process of education especially in the under-resourced schools.

However, a number of difficulties are realized in the research. It was quite common among teachers that they did not feel sufficiently prepared and that they could make active use of AI tools. One of the greatest impediments to functional applications was found to be the absence of professional growth. Overall, the research reveals the possibilities of AI-based learning and has shown that teachers should be better trained and encouraged to practice on the institutional level.

Keywords: Artificial Intelligence, Students, Co-teaching, Schools, Science, AI-based learning.

Introduction

The literature regarding artificial intelligence (AI) in education has largely defined its application as a facilitative tool of teachers in the classroom. Rather than eliminating teachers, AI collaborates with teachers in order to aid teaching and learning processes of students. As a co-instructor, it enhances the participation of students and enables them to consider each student individually. The application of AI tools to the world of primary education is used in many various ways in order to streamline the educational process; in the vast majority of situations, AI is mandated by the majority of institutions to improve the quality and level of intercourse between the students. The conventional classroom environment is typically linked to massive student population, insufficient instructional facilities, and any other obstacle to student involvement. Such

problems have remained influential to poor learning in most learning systems over the decades. The answer to these issues is AI-assisted co-teaching since, using the assistance of AI-based applications, the student will have a personal learning experience and immediate feedback, which will allow him to study at his own pace. This is more appropriate to take things into cognizance and students can obtain their mental abilities in a more professional way.

AI application in primary education in Pakistan must be integrated particularly in the underdeveloped regions. There are serious issues in terms of education in such areas as District Khyber Pakhtunkhwa. These schools are usually overworked and congested, lack access to technology and lack teachers who are trained in the respective area. Despite these obstacles, there is a general positive outlook in the community concerning the possibility of AI in the education sector. As the access to technology becomes more established and AI tools are further enhanced, the education of students in disadvantaged areas will also be able to become better.

The beneficial classroom resources that AI can provide are personalized learning material, evaluation tools and even online learning support just to name a few. Such tools as gamified learning, virtual learning assistants, and intelligent tutoring systems can help make students more engaged under the help of AI. Overall, the implementation of AI practices could be significant in terms of allowing the co-teaching method to work and boosting academic performance among students.

AI co-teaching is a very necessary change that is transforming the aspect of learning by placing the student as the focus of attention as compared to the teacher who was formerly the focus. As Holstein and Aleven (2025) have given the example of AI, it is possible to show that AI can enhance the learning process by making it more personalized. It implies that educators will be in a position to scale their lessons according to individual needs of the separate learner and this will help them learn more and become more interested. Besides, AI-based learning tools can give an educator data about the student progress and enable them to plan the teaching process better and make effective teaching decisions. This benefit is especially important in these places as Khyber where there can be quite a number of students. The role of student engagement in the elementary education can hardly be overestimated; student engagement is among the main factors that lead to the academic success. When the learning process is stimulated well, learners turn out to be more successful, stay longer in school, get more motivated, and strive more to overcome the drawbacks.

In their study of student engagement, researchers rely on three key dimensions of student engagement namely, behavioral, emotional, and cognitive (thinking) involvement. Behavioral engagement would involve the degree to which students are involved in the learning process; this is reflected in the capability of asking questions, discussing course content and doing a given task. Student emotions relate with emotions and feelings of students about school, e.g. the level of excitement of a student, the level of interest of a student, and degree to which a student feels that he/she belongs to a classroom. Cognitive involvement refers to all that relates to the profundity of thought amongst the students. This is through brainstorming, doing what they already know, reasoning and problem solving respectively. The benefit of the AI as a co-teacher is that it may provide personalized and interactive learning opportunities that improve all three methods of student engagement. The issue that has been experienced in the Khyber District schools is the attendance of students in the learning processes. There are large numbers of schools with low records of reading and writing, inadequacy of teaching materials and teacher support. As a result, the learners tend to become disoriented and are unable to focus on what is taught. These educational gaps can be bridged with the help of AI because the robots can help teachers to design lessons that would be attractive to every learner and their learning styles. It can be used to develop learning games, tasks, and exams. Such instruments can be used to make learning process more interesting to the students. Research has revealed the motivation and eagerness to study in students to be improved when learning experiences are tailored. Interesting learning books and games can be useful in maintaining the attention of the students.

The field of education receives tremendous opportunities with the help of technological progress such as AI. There are numerous obstacles in such poor economically calculated regions as Khyber, though. A number of

institutions lack a uniform technological platform, access to the internet, as well as adequate teacher training. There are also no AI tools and training required by instructors in remote plants. A lot of educators are not familiar with the contemporary technology and do not receive sufficient training on the usage of AI in the classroom. The capacity and readiness of teachers to the introduction of AI in the classroom is an important aspect that defines whether the implementation of such technology can be successful in the classroom. Therefore, to truly use the potential of AI in the schools, the teacher training and access to technology ought to be improved.

This paper is about the application of artificial intelligence (AI) as a helper in educational organizations. It sheds light on the possibilities provided by AI in terms of providing the underlying educational objectives, motivating pupils to be more active, and the requirements of primary school. This paper examines the application of AI in enhancing education and learning in schools that are under-resourced. The scarcity of books, staff shortage, and equipment are also among the problems of most schools in the world. In such cases AI would be an advantage in decision making process. The paper discusses the way AI can be used to support the daily activities of teachers - create simple learning tasks, provide practice to the students, or control the classroom. It is significant in the early education especially where introducing a sound foundation in the background subjects is very critical.

Here we are not so concerned about the ways of how AI can assist teachers, administrators and tech entrepreneurs. Many educators who are employed in the low-resource environments have not been prepared to comprehend how AI could benefit them in their practice and result in a better learning experience among the students.

This is the question under which this study is focused. It will discuss practical and affordable methods of maximizing AI in classes with low resources. It is targeted at proving that technology does not have to be expensive and bling to contribute positively to education. The primary school orientation would also mean that the study would focus on offering better platform to the young learners and the teachers despite the difficult resource environments.

Methodology

We were interested in our study to determine the effect of an AI assistant in a classroom and how students engaged in a lesson. Our specific schools were primary schools in Khyber District. The consequences of the application of AI have been literally quantified depending on the quantitative data that was mostly gathered through survey, observing classes and through performance checking of the students. In the following sections, I will discuss the research setting, respondents and the research methodology that we employed in collecting the information.

Research Design

The research was quasi experimental of a before and after (pre-test and post-test) research study design. It was to assess the increase or decrease in the engagement of the students under the condition of AI tools use implementation in the classroom.⁴ The learning process was introduced, which involved AI tools and human teachers, and performed within three months. To understand whether there was any effect of AI tools we also established their levels of engagement at the baseline and at the end of the three months.

Additional Details

To ensure the correctness of the findings, the same engagement survey was employed to conduct the pre-test as well as the post-test to ensure that the results remained the same. The real involvement of the students in the classroom was also noticed so as to know whether the students participated in the classroom according to their surveys. The final analysis was that of the two datasets that were employed to test the hypothesis of

whether the implementation of AI caused statistically significant improvement in the student focus during their lessons.

Participants

The criteria that we were fixated on were to visit schools in the very remote and underdeveloped rural areas with scarce resources and this is the reason as to why we selected six primary schools in Khyber District. Our sample size was 240 children who were aged between 6-12 years. A randomization was done to select the students in the various grades (1-5) in the various schools with a variety of students in order to have a broad perspective. The schools that we selected just coincidentally matched the requirements of our research needed i.e. they were furnished with computers, internet and willing to participate. The teachers who volunteered to take part in this study were full time teachers with an experience of not less than two years in teaching. This study preceded a small workshop on how to use AI tools on the teaching methods by these teachers held before the study.

Such AI tools were designed to assist the teachers in providing more individualized lessons, adopting the needs of the students, providing continuous feedback, and guiding the students through their learning process. This study involved the AI as a classroom assistant or a co-teacher.

Collecting Information

The effect of the AI system, which is applied as co-teachers, on the students was one of the aims of this research. To achieve this, there are various tools which were adopted in the accumulation of data and information.

Student Involvement Survey

To quantify the engagement of the students, the students were surveyed before the study and after the study in three areas of their involvement which include:

Behavior: The extent to which they engaged in it and the intensity with which they engaged in the behavior.

Emotion: Interest and joy.

Thinking (Cognitive): How they are well skilled in the art of critical thinking and trying hard to learn things in detail.

There were 20 questions in the questionnaire. The scale that the students chose to rank each item was out of 1 (strongly disagree) to 5 (strongly agree). The initial survey was conducted prior to the commencement of the study. The questionnaire administered occurred after 12 weeks of AI co-teachers' practice.^{8,9}

Observation is used to measure the work in the classroom.

To identify the project effectiveness, we were observed at the classrooms where we could see how engaged the students were. We have dwelled upon three great points:

On task: The skill to focus on the lesson or utilize the AI tool.

Off-task: Inattention, lack of concentration and distraction.

Active participation: This means making an involvement such as responding to questions or facilitation.

To record these behaviors, we were using the schedule of five-minute time frame and paid attention to the behavior of students during the lessons, during which the AI tool was used.

This was observed using an observer who was not in the teaching staff over a period of two months and totalled to 72 hours of classroom observation.

Measuring Student Learning

The other outcome that we desired to achieve was to determine whether increased student engagement would also result in increased learning. To ensure this, we would check on their school performance.

These tests were aimed to see:

The level of content that the students were conversant with.

How far they were able to use their knowledge in problem-solving, in using ideas and manipulating the acquired concepts.

Understanding Student Engagement

To decide on the impact of AI on student participation we analyzed the data collected by:

Surveys

Classroom observations

The performance of the students in academics.

This knowledge allowed determining what was changed.

Engagement with the Results

Knowing the Response of Students.

To determine the extent to which the interest of the students would be altered after the introduction of AI, we checked:

- Responses from surveys
- Classroom observations.
- Student academic records

Evaluation of the Survey Results

To check whether the involvement of the students was altered, we compared the outcomes of the surveys prior to and after the implementation of AI into the classroom. We took into account three dimensions management, emotions and thought processes. Specific statistical analysis tool (paired sample t -test) was used to determine the level of improvement in such scores.¹⁰ This was a representation of how AI co-teaching has a positive effect on student engagement with learning process.

Analysis

We processed the data related to classroom observation to determine the time that students spent focusing (on-task) and not focusing (off-task) during AI-assisted lessons. The frequency of these behaviors was tested by us to acquire the insight of changes in student engagement and focus during 12 weeks of program. The modifications in the on-task and off-task behaviours were contrasted by using a method known as chi-square. We also used student grades (achievement data) of lessons before and after AI-assisted lessons. We have applied paired sample t-test to test the difference in the performance of students. This helped us to observe how interaction of the students could have increased with differences in academic performances.

Ethics Acknowledgments

The necessary ethical consent was obtained between the authorities of the school and the school administration. To be transparent we shared with all the participants the school policies with regards to the parental consent. The nature of the research was also taken into consideration and this is the reason why we filtered information that would be age-appropriate to the students.

We gave advice to all the study subjects, and gave them consent. We assured them that they are allowed to or

not to do as it was a voluntary exercise. To maintain confidentiality, we coded all the individual names and combine the information as we initiated the analysis. At all times we were geared towards ethical utilization of technology and also treating students and teachers equally.

Result

This paper discussed how AI as a teaching mate led to interaction among elementary school learners in Khyber district in Pakistan. To derive the results, the researchers pooled and compared the data of student survey, classroom observation, and school performance. The findings are geared toward the student engagement differences in three dimensions, namely behavior (actions), emotions (feelings), and cognition (thought processes). These changes were quantified and compared by comparing the data about the students prior to and after implementation of AI in the classrooms.]

Findings of Student Engagement Survey

The researchers used a survey of the students, at the commencement of the research and after twelve weeks of the first survey. This questionnaire was evaluating three forms of engagement i.e. behavioral, emotional and cognitive.

The next section will contain the average scores of each of these three areas using simple and complex statistics in illustrating the extent of changes in the scores of students following AI introduction.

Table 1 Paired-Samples *t* Test Results for Student Engagement Scores (*n* = 240)

Engagement Domain	Pretest M	Pretest SD	Posttest M	Posttest SD	t(239)	P
Behavioral Engagement	3.14	0.84	4.12	0.75	6.85	< .001
Emotional Engagement	3.22	0.91	4.03	0.79	5.77	< .001
Cognitive Engagement	3.11	0.84	4.05	0.76	7.32	< .001

Note. M = mean; SD = standard deviation. All comparisons were conducted using paired-samples *t* tests.

Behavioral Engagement

The behavioral participation can be attributed to expression of the involvement of the students in the classroom setting in terms of their behaviors. This can be determined through such behaviors as being attentive to the lessons, being engaged in activities, obeying instructions and efficiency when using learning materials. These are some of the activities that are indicative of the extent to which the student participates in the learning process.

The related mean scores of behavioral participations in the students were measured at the baseline of the intervention and at the end of it.

Table 2. Behavioral Engagement Score (Pre-Test vs Post-Test)

Time Point	Mean	Standard Deviation	t-value	p-value
Pre-Test	3.14	0.84	6.85	0.0001
Post-Test	4.12	0.75		

The pre and post-intervention behaviors engagement scores.

Standard Deviation t -value p -value at the assessment stage.

t-value =6.85 & p-value <0.0001

Before intervention M=3.14, SD=0.84

After intervention $M=4.12$, $SD=0.75$

It had a statistically significant value because the statistical analysis of the outcome conducted using paired sample t-test proved ($t(239) = 6.85$, $p < 0.0001$). These results show that the application of artificial intelligence as a learning tool positively influenced the classroom interaction of students.

Emotional Engagement

The term is applicable to the attitude of the students towards learning process and interest and pleasure in specific.

Table 3. Emotional Engagement Score (Pre-Test vs Post-Test)

Time Point	Mean	Standard Deviation	t-value	p-value
Pre-Test	3.22	0.91	5.77	0.0001
Post-Test	4.03	0.79		

Table 3 shows the result of the emotional engagement after the test and before the test. The results also improve greatly post-intervention. Mean score in pre-test was 3.22($SD= 0.910$), and the mean score in post-test was 4.03($SD=0.79$). The t -value (5.77) and the p -value (0.0001) support the idea that the improvement is statistically significant, and this indicates that the intervention had a positive effect on the emotional attachment to the learning process among the students. ^{5,6}

Cognitive Engagement

Cognitive engagement refers to the way the students are thinking and working mentally in the teaching hours. It involves such aspects as problem solving, critical thinking and application of knowledge obtained.

Table 4. Cognitive Engagement Score (Pre-Test vs Post-Test)

Time Point	Mean	Standard Deviation	t-value	p-value
Pre-Test	3.11	0.84	7.32	0.0001
Post-Test	4.05	0.76		

The table illustrates the cognitive aspects of the students in the case discussed above.

The cognitive activity and classroom participation among the students as shown in the table increased from the beginning to the end of the study.

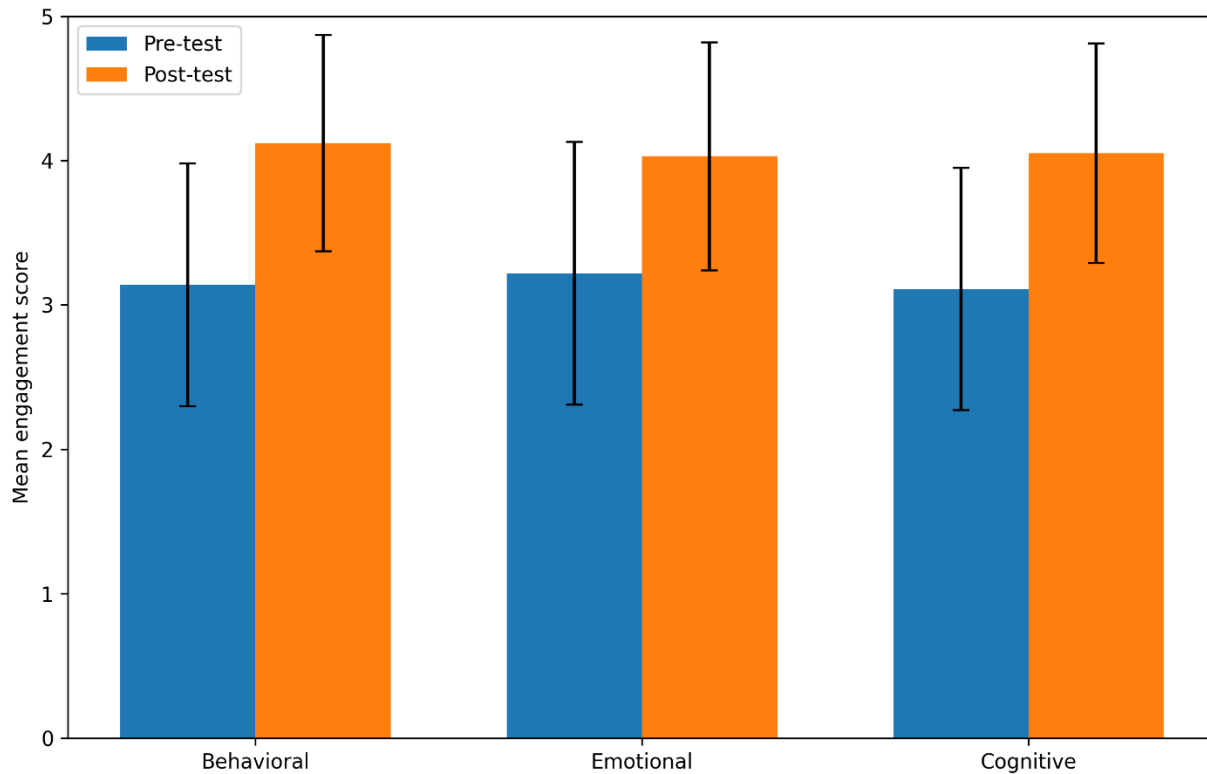
Mean score increased to 4.05 against 3.11.

This change was found to be not accidental, as a t-test statistical test confirmed:

$t(239) = 7.32$, $p < 0.0001$.

It implies that the implementation of AI in education raises the level of concentration of the students and their interest in studying.

Figure 1.



Classroom Observations

This report elaborates on the impact of AI application in the classroom with regard to concentration of the students in their work.

Researchers could track the students to establish whether they were still on task or they lost focus.

Summary of Findings

The two kinds of behavior were compared in the experiment compared to how it was prior to the introduction of AI and after AI was introduced:

On-task: It comprises the active involvement and focus.

Off-task behavior: It is any signs of lack of concentration on the assigned task.

According to the findings, AI tool usage brings about the high levels of student concentration.

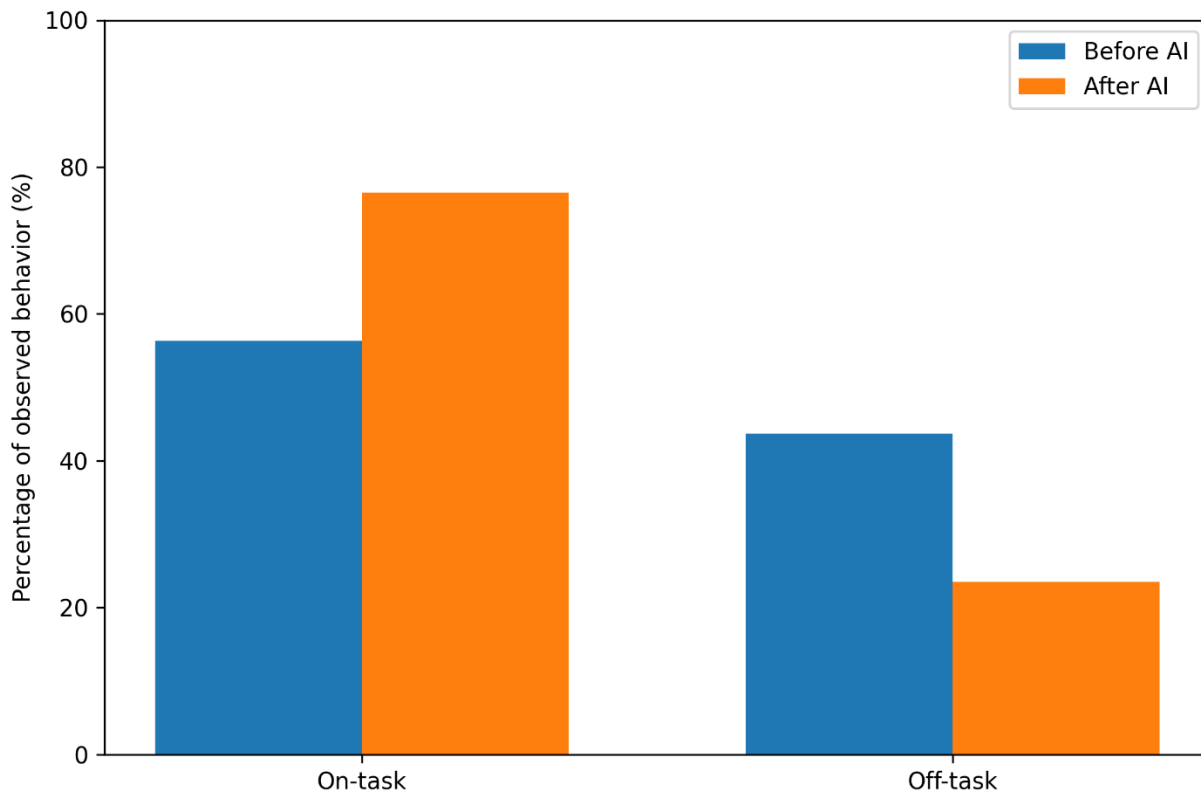
Data Results

Table On-Task & Off-Task classroom behavior before and after AI Integration.

Table 5. On-task & Off-task Behavior

Observed Behavior	Before AI (%)	After AI (%)	change
On-task Behavior	56.3	76.5	+20.2%
Off-task Behavior	43.7	23.5	-20.2%

Figure 2.



- Increased Focus: The concentration of the students increased to 76.5.
- Reduced Distractions: The off-task behavior was reduced to a considerable degree and the rate of distraction was also reduced to 23.5.
- Statistical Significance: These results are taken to be extremely unlikely to have occurred by mere chance with the p-value of 0.0001 indicating that the AI tools have contributed to the improvement realized.

above table depicts the results of behavior research before an intervention and after an intervention.

- There was a significant increase in on-task behavior of 76.5 in comparison with 56.3.
- The percentage of off-task behavior decreased to 23.5 per cent and 43.7 per cent.
- The t-value (8.24) and the p-value (0.0001) demonstrated that the enhancement of the on-task behavior is statistically significant.

This is to mean that the intervention helped students to be more concentrated.

Exam results: Academic performance Results.

Summary table (pre-test vs. post-test)

Mean improvement of the pre-test mean and post test mean t-value p-value.

Table 6.

Subject	Pre-Test Mean	Post Test Mean	Mean Improvement	t-value	p-value
Mathematics	65.2	78.3	+13.1	7.11	<0.001
Science	68.1	81.2	+13.1	6.98	<0.001
Language Arts	70.5	84.0	+13.5	8.22	<0.001

A lot of progress in all subjects.

All of the three subjects were statistically significant ($p < 0.001$).

The highest improvement was done in Language Arts (+13.5 points).

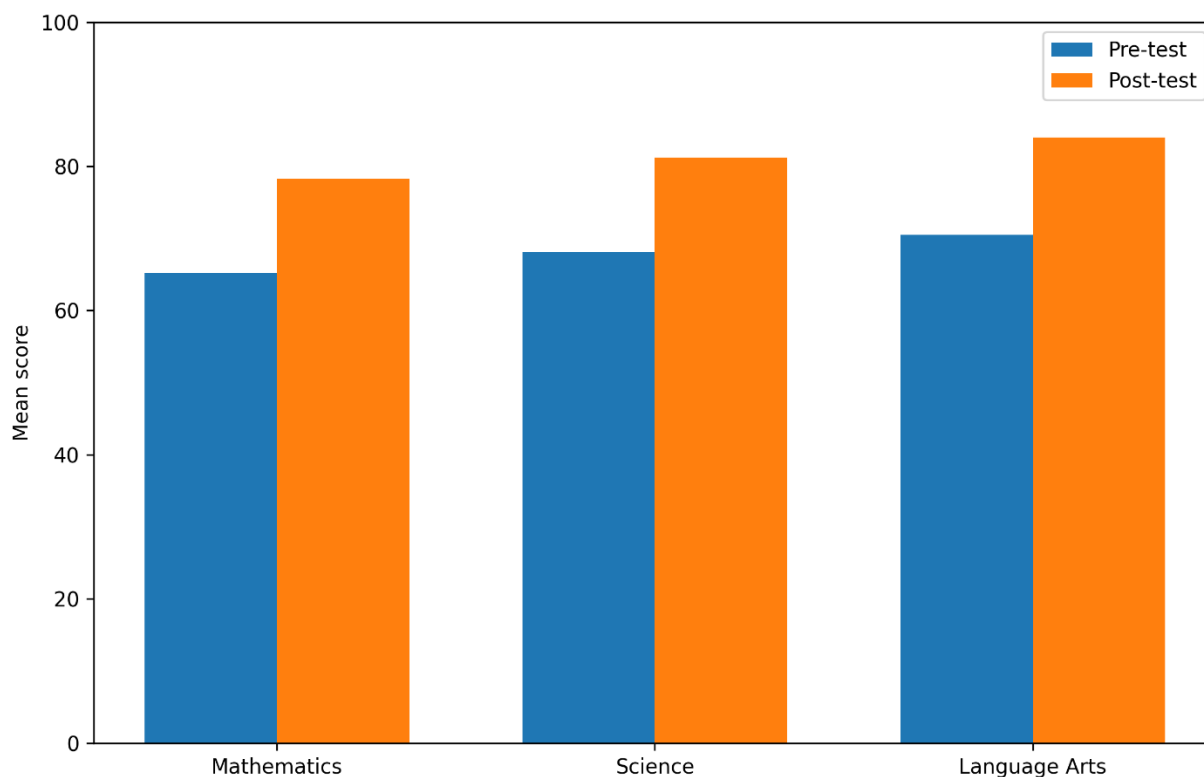
Science and Mathematics were also better & improved by +13.1 points.

Highest Performance

Pre-test: Language Arts (70.5)

Post-test: Language Arts (84.0)

Figure 3. Visual: Academic progress



Mathematics = 65.2 78.3 +13.1 7.11 <0.001

Science = 68.1 81.2 +13.1 6.98 <0.001

Language Arts = 70.5 84.0 +13.5 8.22 <0.001

Summary of Results

The data obtained in the course of student surveys, teacher assessment, and test results demonstrates that implementing AI as a helper teacher in the elementary schools is highly helpful to the students.

The student participation in the classroom was more evident among the students in three aspects:

- Behavior: They were more active during the classroom work.
- Emotional: They were more enthusiastic of the lessons.
- Cognitive: They dedicate more of their energies on academics.

These improvements were confirmed by those teachers who followed the classes. They have discovered that the students were more focused on what they were doing and were less distracted. The test scores also established that students scored at significant higher side in mathematics, science and language arts.

Discussion

This paper will involve the discussion of the use of Artificial Intelligence (AI) to practice as a helping teacher in the elementary school of District Khyber, Pakistan. The findings have demonstrated that AI resources facilitated greater participation in learning activities among the students, because it enhanced behavioral and emotional participation and cognitive participation. This later resulted in improved performance at school.

These studies and findings have been consistent with the previous research. Using the example, Fredrick et al. (2023) were capable of demonstrating that learners achieve improved academic results when they are engaged, whether in their actions or their minds. Our investigation revealed that there were observable changes in the classroom behavior and doing assignments by the students after the implementation of AI resources. This means that AI can provide a learning environment which will enable the students to be more engaged in the learning process.⁷

Additionally, Holstein and Aleven (2025) have found that adaptive AI tools that enhanced the needs of students led to the increased levels of engagement levels in the classroom. In our case, the AI tools were utilized in providing individual learning directions to the students and this kept them within the topic. This observation is in concurrence with the research that has been done on intelligent tutoring systems in the past. Moreover, the Artificial Intelligence (AI) use in classes allowed the students to emotionally engage in the classroom. Positive feelings contribute to the intention of AI systems that are supposed to establish emotional engagement. Ding et al. (2025) state that the interest of learners grows through the application of AI sources with game-like elements. Clark et al. (2023) also include that the motivation to learn among students is heightened when AI learning platforms are used, including quizzes and through the use of games. It has been also reported that students like and take their classes more seriously, which is an indication that AI tools enhance emotional appeal.

The cognitive ability and understanding of the students were also enhanced, and this implies that AI resources help students to gain a better insight into more complex issues. According to Rasheed et al. (2025), the AI tools stimulated the process of the students having the possibility to think in a highly critical manner. These were more Equi prehensive as they would support the learning levels of students. They contained special features which had enabled students to learn in their own pace.

The study indicates that the students used more time studying and were not distracted. This is consistent with the results of Raza Farooq (2025) since he stated that the use of AI applications assisted learners to be concentrated, their off-task behaviour decreased to the lowest level and even helped learners who lost interest to resume it. The AI educational resources used by learners in the given study could provide them with instant feedback, tasks that were challenging yet equally challenging depending on their skills, and learners were interested and motivated to learn.

Enhancements in Learning

These results are in line with other studies that have indicated that the use of AI in classrooms causes an increase in student performance, particularly in performance in subjects such as mathematics and science. The AI was used in the respective study as it was able to improve the performance in mathematics, science and language arts. It implies that AI is not only used to materialize the attention of students in a more efficient manner, but the results of academic performance are also promoted. The collaboration of AI and teachers, i.e. co-teaching, will be particularly useful.

Limitations

Nonetheless, challenges exist. Other schools, like the ones found on the District of Khyber, do not have the technical equipment needed, and teachers may not be trained enough on how to utilize AI. Moreover, the AI materials used in the research were purely English and this was discriminatory of the non-English speaking

students. The further research on this subject matter should be directed at the availability of AI tools in the local languages so that they could be inclusive.

Recommendations

In conclusion, AI may be applied to enhance the interaction and achievement of the students, as this paper promotes the concept. There is a lot of potential of AI particularly among young learners. However, the process of AI utilization in the education sector will be more productive with improved technological facilities and the training of the teachers. The implementation of AI in rural and disadvantaged populations in the long term should be also included in the investigation in the future.

Conclusion

The Khyber Pakhtunkhwa primary education teaching has undergone a revolution due to introduction of Artificial Intelligence (AI) and the teachers. The behaviors, feelings, and cognitive activities of the students showed an increase in activity of their learning processes as AI contributed to the students having individualized lessons, receiving feedback immediately, and learning more actively through multiple activities.

It is that there is a greater number of students becoming more engaged, enthusiastic and delivering higher results which mean that AI can be utilized to enhance the learning process. However, several obstacles were also erected within the study, which were unequal access to digital-based materials, deficiency of technology, and training of teachers in the use of AI.

To make the most of the AI opportunities in the learning sphere, the digital access gap should be overcome. The future studies would aim at culturally responsive AI or the general impact of AI on the real academic performance of students.¹¹

In conclusion, it should be highlighted that this paper has shown that AI has a potential to enhance primary education in resource-poor regions, particularly to re-engage the students, and to offer new approaches to the educators to communicate with students.

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