

## The Use of AI in Early Childhood Education Psychological Implications for Attention Memory and Social Development

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### ABSTRACT

The purpose of the research was to determine the impact of interactive Artificial Intelligence (AI) instruments on attention and memory improvement of 6-10 years of primary school students in the Islamic Republic of Pakistan, Punjab. This was a quantitative design where the population sample size was 230 students with the snowball method of population sampling incorporating the government and the private schools. It involved collecting data using a structured questionnaire and data analysis which was in form of correlation, regression and ANOVA. The findings have revealed that there is a positive correlation that exists between the use of AI tools and the level of attention among children. Regression analysis also indicated that interactive AI-Based tools were a very good predictor of memory enhancement in the students. Beyond that, the findings of the ANOVA provided further evidence by confirming that there actually exists a cumulative difference in the outcomes of the cognitive skills based on the frequency of using AI tools. The article supports the work that has already been done concerning the necessity of the introduction of digital tools helping to raise the level of engagement and performance rates among students. It makes an inference that with the extensive use of interactive AI-based programs, it is the cognitive steady younger learners develop to the positive effects of interacting with various programs. The researchers recommend that AI-based learning at the early education level should be promoted. Future research should venture into the long-term implications in addition to taking into consideration the other logical and emotional components of learning to provide harmony in the AI-based learning experiences.



## **Introduction**

Artificial Intelligence (AI) is a very powerful instrument used in learning over the past few years, especially in early childhood settings. Reading robots, dedicated learning smartphone applications, and voice-controlled tutors are some of the AI-powered systems being used to support learning amongst children as young as two or three years of age (Liu et al., 2024). Using the example of telling a story by means of a storytelling robot with AI options available, the child ought to customize the linguistic level to the level that he or she can understand in order to improve his or her vocabulary and comprehension skills. However, even with the above-mentioned list of positive effects linked to the above technologies, there have been concerns about the effects they have on the psychological growth of a child- more specifically, in matters relating to the child in terms of their attention spans, memory formation and social behavior. The importance of understanding the possible impact of AI on such crucial areas of development is that the early childhood is a vulnerable period of brain development and maturation (Papadakis, 2021).

The widespread popularity of the AI relevance in the issue of capturing the attention of the little children produces an even more space of care and interest. One of the fundamental skills that help to simplify the process of studying, self-management, and communication is attention. The interactive games or other adaptive learning tools are also designed in a way that they are also able to make the child concentrated through the sound effect, animation responses and the feedback the child gets immediately. They allow one to put in place features and activate interaction to facilitate the time-on- task when learning activities have been attained. But it is a possibility that in long run the fast paced and eye-popping quality of some apps that are on AI basis are depriving a child the time to play and consequently therefore impacting it negatively in long term in terms of focus span as a result of a cycle of immediate remuneration and picture-based responses. Studies have found that these children later documented trouble maintaining concentration when exposed to less informal learning processes when they had been subjected to a lot of digital stimulation (Radesky et al., 2023).

Another one of the essential areas that are affected by the implementation of AI in early education is memory development. Memories enable the children to keep information and solve problems and make meaning of their experiences. Artificial intelligence can also help improve memory by providing repetitive training, images, and feedback, as they help in learning. Individualized AI tutors, say, will be able to measure the progress of a child, and direct him or her with content to focus on the memory deficient areas, so that it may be corrected later. Such evidence-based methods as repetition and spaced learning, which are often utilized when dealing with the learning of AI applications, are found to enhance memory retention (Kang et al., 2016). While this interest in turn results in concerns being raised by people on matters when children are over reliant in finding answers through AI or excess passivity consumption including viewing AI produced videos whose content is not actively engaged in. This may restrict them to think on their own and create a long-term memory.

## **AI and Attention Development in Early Learners**

Attention is one of the key skills which children acquire in early childhood. It will help them to be successful in learning tasks, be able to listen to instructions and undertake tasks to confront challenges. The application of AI technologies such as apps that people should learn, robot, and games are now used in the classroom and at home to make children focus their attention on them. It also involves some artistic colors, humorous sound and quick responsiveness to the input of the kids in these tools therefore making the learning process more enjoyable and fun. The high speed

and flash content can very easily become the norm to the children and then they will find it challenging to focus in the normal classroom setting that is slower and not flashy. Therefore, on the one side, the use of AI may help children to maintain their attention, and on the other, one may speak about the existence of some risks connected with such effects as origin of attention development promoted by the use of AI (Christakis et al., 2018).

AI can also help in aiding the attention of children in a manner that is more systematic and accommodating. Most of the current AI applications can be programmed to gradually have the child spend more time on an assignment so that they know how to focus longer. The difficulty level of some AI systems will increase or decrease depending on how the child is doing, and this prevents exhaustion of the child. Such a balance is significant as it enables the child to retain interest, without having to get bored or feel stressed. Also, AI can educate the children in the skill of transferring attention from one task to another, which may be quite a good skill during learning as well as during regular life. As a practical example, an AI-based learning app may encourage a child to transition between a puzzle and a story-based task in a way that does not force the child to think flexibly, but only encourages such thinking. AI under a well-guided usage can serve as an assistant in the challenges of creating attention control. Nevertheless, adults should pay attention to the way such tools are utilized. There will be a lack of influence of teachers or parents on the way children use AI, so they may not do so in formats that help them to learn in reality. Supervision assists in understanding how the attention of children will be promoted by the AI with no accounts of the interruption of the natural learning process (Caruso & Fawcett, 2014).

Although AI has many beneficial attributes, it cannot be the only tool to cultivate attention in the early students. Concentration is also enhanced by real life tasks that are associated with bodily movements, creativity, and human interaction. Old fashioned games, storytelling activities, drawing, and outdoor activities can teach children the importance of being able to focus, to take turns and staying focused on what they are doing without the use of a screen. Such activities foster high levels of concentration and patience which is more difficult to foster using fast moving digital tools. Besides, communication and emotional skills which aid self-control and concentration develop with the exposure of the child who plays with the adults and the other children in such encounters. A proper combination of digital and non-digital learning is the best way through which children learn. By doing this, AI can be used as a part of the balanced learning methods that can assist the children in developing as the whole people with the regards to their mental, emotional, and social needs, without being over dependent on the screens (Karapet & Misak, 2024).

### **AI's Impact on Memory Formation in Childhood**

Memory is one of those basic skills that helps the kids to memorize what they study and use it in one way or another. The current use of AI tools in early childhood learning is in the area of memory boosting by offering individual learning brink. To illustrate, AI applications involved in reading-teaching can repeat hard words and narrate the scenes of a story and make kids guess. This can be facilitated with the aid of such plans as spaced repetition and feedback that will facilitate the creation of a better memory association. The studies of the recent years corroborate this idea. (Sun & Kang, 2022), found out that their memory will be improved with the use of the AI tools that will alter the pace of the learning process to work better with the performance rates of the kids. Similarly, (Liu et al., 2025), promoted the relevance of the same pattern since the positive connection to the same strengthening in memory retention was associated with the ability of AI-based learning (regular feedback and repetition) to strengthen the memory retention in preschoolers.

Even though AI can assist memory, it can be a problem in that children who have a tendency of entrusting AI excessively with fulfilment of tasks will end up using it a lot. Other scientists describe the fears that AI will make children lazy i.e., they will no longer even bother to memorize something themselves because AI will always be able to help them on it. Active memory development is likely to be developed by the real life experiences like rehearsing stories, asking questions or solving problems. The activities cause the kids to work on their memory muscles and the brain becomes more developed. According to (Mushtaq et al., 2024), excessively dependent children on the screen-based features expressed inferior remembering abilities when exposed to no technological resources. (Fernández et al., 2016), therefore attained a conclusion that the overuse of digital memory aid conditions fail to support the natural memory growth among the early learners. Emotion and social associations also assist in memory especially in a case where a child is playing or in a conversation with the other people. They are plentiful experiences, and it is difficult to perfectly reproduce these with the help of AI.

The AI would need to be integrated in a balanced learning program whereby a student would see it as positive in as far as memory development is concerned. The working of the AI tools is followed by the letting them know what they have learned with the assistance of their parents or teachers. It is a process that is employed in an attempt to shift information, which has been encoded in the short-term memory, to the long-term memory. It is possible to say that AI-apps can identify the fields in which a child is struggling, but a teacher can put the knowledge subjects in relational terms. As an example, after doing a vocabulary exercise with the help of AI, a parent can ask a child to give an instance of the new words in a sentence or story. As it was dynamically shown by studies that were conducted by (Iqbal et al., 2025), the integration of AI-based learning with socialization with a teacher ought to contribute to markedly increasing the indicator of children memory skills. Similarly, (Jamal-Camden et al., 2024), pointed out explicitly that children were more willing to learn when the lessons supported by AI were discussed with people

### **Research Objectives**

1. To examine the relationship between children's exposure to AI-assisted educational tools and their levels of attention development in early childhood settings.
2. To investigate the predictive influence of AI-supported learning experiences on memory retention among preschool-aged children.
3. To explore differences in attention, memory, and social development outcomes among early learners based on varying degrees of AI integration in their educational environments.

### **Problem Statement**

The use of Artificial Intelligence in early childhood education is consuming the industry at high rates and majority of schools and parents are settling on the adoption of Artificial Intelligence facilitated technologies to make use in educating young children such as learning applications, robots, and intelligent scarves. These tools will presuppose easing the process of education and making it more of individual and accelerated in terms of meeting the needs of a particular child because the material is modifiable to their level of learning. Though this seems to be advantageous, some citizens are complaining on how these technologies are affecting the mental and emotional youths. The early childhood is a very sensitive period in the brain development and proper skills are dawning which include attention, memory and socializing. Failing to apply the tools of AI intelligently, one will end up with the children being distracted so much by the screen that they will never be interested in the process of physical socialization or that they will not be able to pay attention unless there are bright digital stimuli before their eyes. Depending on the magnitude and

frequency of application, some may prove to be of a plus and some might be faced with negative effects with the application of AI.

### **Significance of the Study**

The significance of the research is that it will focus on the impact of Artificial Intelligence (AI) instruments on attention, memory, and social development of young children as the three spheres of study in the early childhood phase. As more schools and families integrate AI-driven educational technology, there should be a reason to know more about its impacts especially during early years where the developing brains of children are faster. The majority of the AI applications are counter-posed in a constructive manner in order to facilitate a learning process but little has been researched about the effects of the AI tools on a child ability to concentrate and focus on the task, memorize information and socialize with his peers. The findings of the paper can guide the parents, school teachers, and education policymakers on the how and when the AI can be applied with respect to the early learning settings. It can also achieve the vision of making the developers design AI tools that can be more accommodative of the healthy brain and emotional maturity. The study will demonstrate the opportunities (as well as the limitations) of implementation of AI in early childhood education hence empowering users with credible information that can be used to create the correct balance between technology and traditional education.

### **Literature Review**

The application of Artificial Intelligence (AI) technologies in the sphere of early childhood education is also commonplace with their numbers increasing significantly over the recent years. Adaptive learning software, AI-based storytelling applications, and educational robots found their place in many classrooms and homes. The technologies which are proposed are actively advertised in aspects of providing customized learning, giving young children their attention, and improving outcomes of learning. The researchers have proved that young students will be assisted in their studies by the learning tools through which the material will be adapted to their learning speed and preferences (Hudson et al., 2025). However, as much as the tools would assist a lot, the early childhood is too sensitive a phase as far as the development of the brain is concerned. This stage involves blistering growth of concentration span, formation of memory as well as emotional mendacity. Certain investigations assert that, besides having an influence over their educational achievements, relations between children and AI have the potential of influencing the facets of their emotional and mental development (Ahmad et al., 2024).

One of the most valuable skills that a young child develops is attention. It enables children to listen attentively, to pay attention to instructions and to keep their minds focused on the aspects of their learning engagement. Some past research has covered the involvement of AI-based learning facilities in attracting the attention of children through colours, sounds, motion, and rewards. These characteristics can make learning lively, but one can also become over-stimulated and have a very short attention frame when using them excessively (Husain et al., 2023). According to some researchers, children who are more active in utilizing the AI tools of screen-based nature might not be able to concentrate well in the traditional classroom settings which do not have as many digital elements as the former ones. This portrays one of the negative outcomes of being technology dependent. Yet, there is also evidence in the literature that properly made AI can actually assist children with developing better focus as it allows scaling up the task difficulty and helping them solve the problem (Zedan et al., 2023).

Recent research demonstrates that AI technologies have a positive effect on memory as effective learning with frequent repetitions and instant feedback is possible (Nasir & Fatima, 2023; Chen & Yu, 2021). To give an example, certain AI reading software will instruct a child to recall events within a story or memorize vocabulary words, until they are committed to heart. Such techniques are based on the established memory patterns like repetition and spaced learning that enhance retention. Nevertheless, the findings of other studies indicate that the passive learning of AI may contribute to superficial learning and poor memory associations in children in cases where they watch or listen to the content without engaging and making a conscious effort (Khalid & Iraqi, 2022). This indicates that not every AI tool is effective without exception. Such tools as facilitate children to ponder, recite and practice knowledge promote the memory compared to those that entertain. By relating it to previous findings on attention, one would conclude that it is easy to point out that memory and attention are closely related. Before remembering, the children will need to pay attention. In this way, the usage of AI can influence both the skills conjoined.

### **Digital Engagement and Attention in Early Childhood**

Children currently are raised in a digital world with all of its AI-based learning devices full of loud colors, exciting sounds and immediate rewards. All these features are supposed to enhance more interest when learning and to capture the different attention of kids. They do keep children engaged in most of the cases. But excessive usage of this digital stimulation may create difficulties among children in concentrating in other events. The studies indicate that high-paced and over-entertaining content may decrease the concentration capacity of a child in silent or conventional learning environments (Rana et al., 2022). As an example, a child accustomed to loud and spritely applications might expect to read during reading time at school environment to become bored or distracted. According to researchers, this may also have an impact on the emotional regulation and working independently of the children (Tariq et al., 2025). This concern taken to a new level point to the importance of such a balance between online learning and real-life tasks that help a child work on patience and attention.

Although attention deficit can be caused by certain AI material, effectively implemented artificial intelligence instruments and devices may, in reality, assist in the process of educating kids to stay more attentive. Slowly editing the difficulty of activities or rewarding problem solving other than speed is also how AI platforms have been identified to create attention in the long-term (Abid et al., 2023). Such tools are used to teach children to persist longer at what they are doing, and to think more profoundly. As an example, not all AI math apps reward success by providing a reward to the correct answer, but also teach the same lesson by asking the children to review their mistakes and to correct them and re-try what they did thus keeping them focused and motivated. These kinds of websites are encouraging of interactive learning as well as comprehension rather than unproductive learning. The studies do confirm the positive effect of the introduction of AI to the adults, when modeling its usage to a child, it is less impactful on a child, and their attention is more positive (Jamil et al., 2023). This indicates the significance of the involvement of the parents or teachers in the ways in which the usage and introduction of the digital tools take place. It is not technology but what you do with it.

The AI impact on the attention closely relates also to the way children memorize what they study, and comprehend it. The child may not be able to retain that information in the memory correctly when he or she is not able to concentrate on that task. To form memory, the child should be able to notice and focus. Before memorizing anything, a child needs to pay attention and pay attention (Rawson & Dunlosky, 2022). There are some AI apps that can promote building memories by reviewing the key concepts and asking children to remember it later. Nevertheless, once the digital

material is too much fun and makes people not think, it can provoke superficial learning (Tariq et al., 2025). It is also scientifically proven that social involvement and physical activity during lessons make children easier to remember and recall information (Nazir & Butt, 2025). That is, attention and memory may be promoted by combining the utilization of AI and story-telling, role-plays, or outdoor games. The combination of both digital and non-digital learning experiences enables kids to be more focused and reminds children.

### **Cognitive Retention Through Interactive and Adaptive AI Tools**

Memory is needed to learn, understand and apply information to life by the child. The AI learning tools support the memory by practicing it frequently, prompts and feedback based on the requirements of a child. Some of the helpful features of these AI applications include spaces repetition whereby it takes the element of repetition to children on the same topic at different times so that they can be in a position of memorizing. Memorization found that memory development is witnessed more among the children who use AI-enhanced reading and math programs due to these repetitive and individual activities (Nasir et al., 2025). With these systems the learning of a child is observed and sets of review given to him or her based on what he or she forgets or is failing. This assists in the enhancement of learning process and in focusing the learning process. But of importance are the uses of the tools that kids employ. There is a higher level of retention when children do something meaningful out of what they are being taught. Correction and repetition when there is the right timing is much better than learning enhanced by curiosity and active seeking (Al Saeed, 2021). So, the goal to accomplish by using AI is to make kids think, exercise and rethink in the same manner as when a good teacher leads children through the process.

Active learning is said to contribute to forming effective memories in the children. Children will remember the material better and internalize the material by making choices and solving problems or answering a question. The passive practice like engaging in watching a video and making no interaction is not helpful in memory formation (Mahmood et al., 2025). Children are required to stimulate the brain to have a legitimate learning. The AI systems need to ask, allude and alter lessons based on the reply of the child. This makes the child feel that it has a place and this also helps him or her brain to learn and store new information. The memory building tools are incorporated in tools which involve playing games and puzzles among other creative activities as compared to provision of information tools. As it is revealed in recent studies, when interacting AI is introduced, the level of knowledge retention or satisfaction with learning can be increased (Bashir et al., 2025). When children are told that they have an active part to play in the process of learning as opposed to watching and listening, they perform better and remember much more. This is why developers and educators are supposed to ensure that AI is not only entertaining but also educational in terms that children will have to relate with content.

Having to learn real-life practices should not be replaced with AI, although AI can be used to support this domain of memory by taking training and partaking. Other processes that are also very important in the memory development process include such activities as storytelling, playtime, discussing, and exploration activities that a person does with his or her hands. When subjected to the screen, the application of the memory varies as opposed to what happens when the kids are listening to stories told by their parents or when the teachers engage in dialogues with them regarding the day. These real life interactions will help the children to connect with emotions and think. Both emotion and the social learning are contributing factors to good memory (Khan & Ghazala, 2023). There must be some combination of these two, children must work with applications powered with AI to read something or have some extra practice but they must read

books, talk to other people, and do something in the real life. The memory enhancing feature of digital learning is augmented further with adult support and follow up discussion (Noreen et al., 2025), best effect of AI is in the ability to incorporate into a chain of learning of a child and not the whole learning process. This way, the children develop perfect memorizing skills in studies and life in general.

### **Research Hypotheses**

**H1:** There is a significant relationship between children's digital engagement through AI-based learning tools and their ability to stay focused during educational tasks.

**H2:** There is a significant impact of using interactive and adaptive AI tools on children's ability to remember and recall what they learn.

**H3:** There is a clear difference in children's cognitive and social growth between those who learn with AI-supported tools and those who follow traditional classroom methods.

### **Methodology**

#### **Research Design**

This was a quantitative type of study design. The research focus was on this type of research since it enabled the researcher to measure and evaluate the connection among various variables in an organized manner. The data was collected through a survey method that was useful in the sampling of a large population in a short duration. The survey comprised of close ended questions on a Likert scale and this was made easier to obtain clear answers. The quantitative method assisted in the investigation of the degree of association between the attempts to use the AI-supported learning tools with the attention, memory, and cognitive development of children. It was also selected on the basis that statistical forms of analysis like correlation and group comparison that can be used in testing the objectives and the hypothesis of the research can be carried out. All in all, this type of research design is suitable when gathering numerical data and then making conclusions about pattern, difference, and relation; when none of the variables is manipulated directly.

#### **Population**

The target population of the study was school going children in their primary education level age 6-10 years. It sampled these students in both the government and the missionary schools that are in distinct parts of Punjab in Pakistan. The population included the students already attending the AI-based learning platforms or tools, used as the form of education. Depending on the circumstances, those tools may include learning applications, educational games, or digital classroom platforms to help children study in the areas of math, language, and science. Notice that the population was selected carefully since during such an age category, there is a critical period of development in relation to attention, memory, and cognitive skills that develop expeditiously. The application of AI tools in schools and households becomes more common, so it is time to focus on ways they may influence the learning process of young people. The children that had diverse backgrounds, educational experiences, and education levels were a factor that was taken into consideration so that the result could be applicable to more people.



### **Sample Size**

The given study was planned to involve 230 primary school students. This figure was selected to make sure that the data to be obtained would be robust enough to provide credible results and reflect the attitudes and experience of the bigger population. The statistical procedures to be used in the research were the test of relationship and group differences and therefore a sample size of 230 was suitable. The participants of the study were chosen because of their habit of applying AI-assisted learning tools regularly, whether at school or at home. It sampled the children in various cities and type of schools (public and private) in Punjab. The sample included both boys and girls and each student with varying levels of learning. The sample was reasonable and enabled the researcher to ensure that he did not overlook in any of the aspects of the analysis. Ensuring that the results obtained were meaningful and could be utilised to determine how the AI tools were effectively operating in real/actual learning settings was important and this necessitated inclusion of a sufficient number of participants.

### **Sampling Technique**

In this study, the snowball sampling technique was applied. The method was chosen due to the fact that it was hard to get a full list of children who use AI-based learning tools in various schools. It was initiated with several familiar students who already benefitted from artificial intelligence-related applications and tools. They or their parents would then be requested to recommend other children who would also use similar tools in learning. By this, the sample was increased step by step such as a snowball rolling and increasing its size. The approach helped in tapping more students who had different backgrounds since some came in regions where digital learning was taking root but even at an uneven rate. Use of snowball sampling method was convenient in that the schools and the parents were more ready to respond to the request that they were referred by someone known to them. Though not a random approach, it proved to be fruitful in identifying the right kind of participants to be used in this study and it assured that it is only students who have experience in learning with AI who participated in the process.

### **Ethical Considerations**

The ethics of the study were strictly adhered to as we sought to guarantee the right, dignity, and privacy of every research participant. Due to the fact that the participants were young children aged between 6 to 10 years, special care was taken to inform the parents or the guardians of the participants before including them in the research. The aim of the study was clearly stated in understandable words in the sense that both the parents and the children could comprehend what was involved in participation. It was ensured that they were being included in the study and could drop out any time with no penalty or repercussion. The identities of the participants were all confidential and the names and personal information of the participants were not documented in any stage of the data collection or analysis procedures. The data that was obtained using the questionnaires was treated as being confidential and therefore used only in the research. Schools that participated in the study were provided with all the information regarding the purpose and the advantages of the research. This research work was carried out in accordance to research ethics and permission was granted by the academic and institutional bodies before the data collection be initiated.

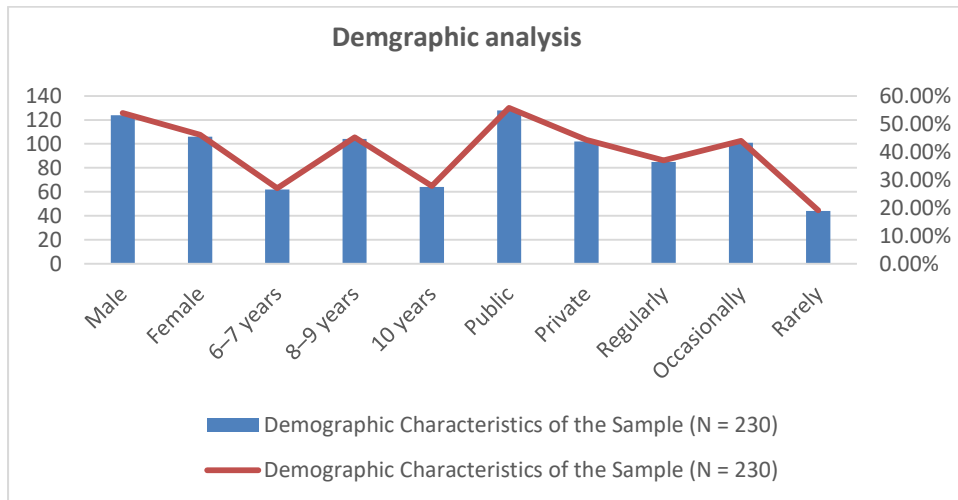
## Data Analysis

Analysis of collected data was done using SPSS (Statistical Package for the Social Sciences) to investigate the relations between the use of educational tools with AI support and cognitive and behavioral achievement of children. Means, standard deviations, and frequencies of demographic characteristics of the participants were calculated to summarize their demographic characteristics. To test the hypotheses that were formulated in the research, Pearson correlation was employed to determine the strength and direction of relationship between the utilization of AI tools and increase in attention. To ascertain the predictive effects of interactive AI platforms on the capacity of children to retain and recall contents, simple linear regression analysis was carried out. Also, to examine the variations in the results of development amid children offered to be in the environment supported by AI and those who were taught in the traditional manner, an independent samples t-test (presented through ANOVA table) was employed. Such statistical methods assisted in making sure that the pattern and associations in the data were understood perfectly and enabled the verification of the postulated hypotheses with a convincing empirical basis. All interpretations of the analyses were done at 0.05 level of significance.

**Table 1: Demographic Characteristics of the Sample (N = 230)**

| <b>Variable</b> | <b>Category</b> | <b>Frequency (n)</b> | <b>Percentage (%)</b> |
|-----------------|-----------------|----------------------|-----------------------|
| Gender          | Male            | 124                  | 53.9%                 |
|                 | Female          | 106                  | 46.1%                 |
| Age Group       | 6–7 years       | 62                   | 27.0%                 |
|                 | 8–9 years       | 104                  | 45.2%                 |
|                 | 10 years        | 64                   | 27.8%                 |
| School Type     | Public          | 128                  | 55.7%                 |
|                 | Private         | 102                  | 44.3%                 |
| Use of AI Tools | Regularly       | 85                   | 37.0%                 |
|                 | Occasionally    | 101                  | 43.9%                 |
|                 | Rarely          | 44                   | 19.1%                 |

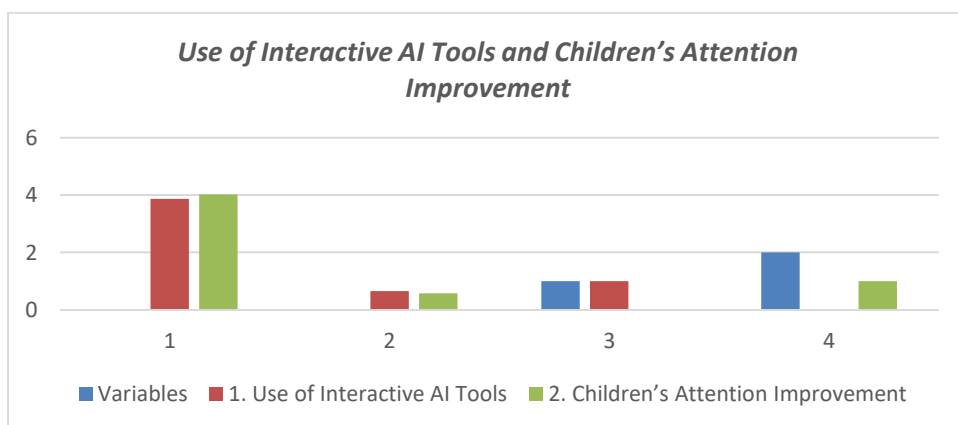
The demographic trait of the sample (N = 230) indicates a fairly equal distribution of male (53,9%) and female (46,1) students of the primary school. The participants were between 6-10 years with majority being between the age 8-9 years (45.2%), 10 years (27.8%) and 6-7years (27.0). Of the educational institutions, the percentage of students were found slightly more in 55.7 percent in public schools than in 44.3 percent in private schools. The frequency of using AI tools was also checked, wherein 37.0 percent of the students stated that they used interactive AI educational tools regularly, 43.9 percent stated that they used them from time to time, and 19.1 percent stated that they rarely used it. These numbers comprise a heterogeneous and convenient sample of young students in terms of gender, age, and the variety of school types with a different level of exposure to an AI-supported learning environment. The distribution will also give a good basis of identifying the relationship between various demographic variables and various key outcomes of the study like the promotion of attention, learning the contents, and cognition of our AI tools.



**Table 2: Correlation Analysis**

| Variables                           | Mean | SD   | 1                                       | 2    |
|-------------------------------------|------|------|-----------------------------------------|------|
| 1. Use of Interactive AI Tools      | 3.87 | 0.65 | 1.00                                    |      |
| 2. Children's Attention Improvement | 4.02 | 0.58 | .61 <sup>&lt;sup&gt;*&lt;/sup&gt;</sup> | 1.00 |

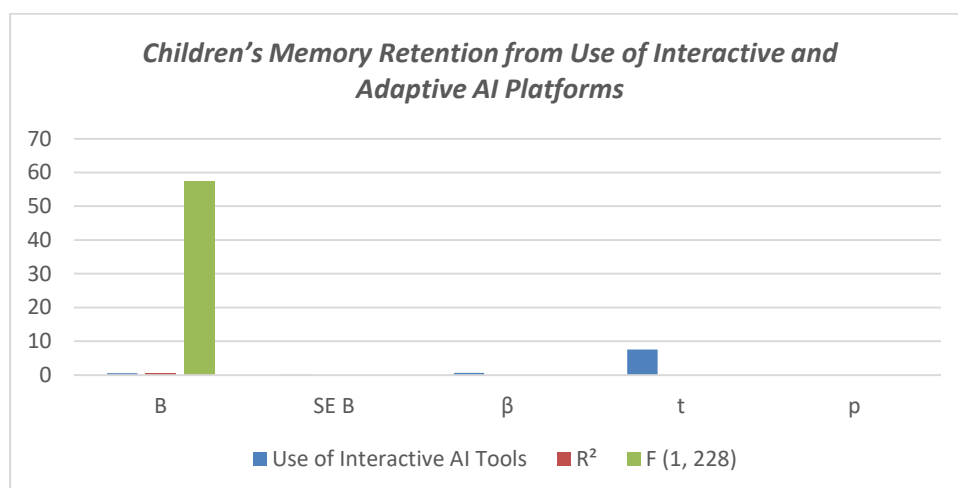
The correlation test of Hypothesis H1 indicates there is a statistically significant moderate level positive correlation between the interactive AI use and enhancing the attentive quality of children ( $r = .61$ ,  $p < .01$ ). The fact that the identification of kids inability to maintain the focus or concentrate when undertaking any learning activity is associated with use of interactive and adaptive AI educational platforms depicts that there will be an improved capacity among children in respect to focusing and concentrating during any learning activity as the use of interactive and adaptive AI educational platform tends to increase. The mean score of AI tool usage was 3.87 (SD = 0.65), and the mean of attention improvement was 4.02 (SD = 0.58), which indicates the general level of both variables among the sample as rather high. The results of this study aid the assumption that interactive artificial intelligence tools assist in the cognitive involvement of young learners significantly. A statistically significant correlation can also hint at the possibility of AI tools that encourage active engagement being useful, with games, quizzes, and personalized feedback being relevant as such tools. The findings confirm the results of the previous studies that associate the use of technology-based personalised learning with a higher cognitive focus within early education settings.



**Table 3: Regression Analysis**

| <b>Predictor Variable</b>   | <b>B</b> | <b>SE B</b> | <b><math>\beta</math></b> | <b>t</b> | <b>P</b> |
|-----------------------------|----------|-------------|---------------------------|----------|----------|
| Use of Interactive AI Tools | 0.53     | 0.07        | 0.62                      | 7.57     | .000**   |
| R <sup>2</sup>              | 0.38     |             |                           |          |          |
| F (1, 228)                  | 57.31    |             |                           |          | .000     |

The findings obtained in regression analysis demonstrate that there is significant positive correlation between the interactive AI tools usage and the learning and remembering skills of children in terms of educational content. The unstandardized coefficient ( $B = 0.53$ ) means that as the use of interactive AI tools will increase by one unit, the score of memory retention of the children will also increase by 0.53 units. The effect size measures (beta value (beta=0.62)) indicated that there is a high predictive power in outcome by independent variable. The statistical significance of this relationship is affirmed by the t-value, 7.57 and p-value, (.000\*\*) respectively. Moreover, the R<sup>2</sup> index of 0.38 shows that about 38 percent of the variability in the retention of the memory is by the utilization of interactive AI tools. The overall regression model is significant as indicated by F-statistic ( $F = 57.31$ ,  $p = .000$ ) in support of the hypothesis that there is a significant contribution of AI platforms on the development of memories in children. The results point to the need to include digital tools in teaching that are adjustable and interactive to stimulate development in students.



**Table 4: ANOVA Analysis**

| <b>Source of Variation</b> | <b>SS</b> | <b>df</b> | <b>MS</b> | <b>F</b> | <b>p-value</b> |
|----------------------------|-----------|-----------|-----------|----------|----------------|
| Between Groups             | 18.42     | 1         | 18.42     | 9.85     | .002**         |
| Within Groups              | 427.65    | 228       | 1.88      |          |                |
| Total                      | 446.07    | 229       |           |          |                |

Based on the ANOVA analysis, a significant difference was revealed between the outcomes of cognitive and social development of children who have been involved in a learning environment with the use of AI-based tools and those who have learned in regular environments. The between group sum of squares ( $SS = 18.42$ ) and F-value of 9.85 with a p-value of .002 ( $p < .01$ ) indicate that, the variation cannot be attributed to chance. The mean square between groups ( $MS = 18.42$ ) is a far larger value than that of the mean square within groups ( $MS = 1.88$ ), thus providing a

stronger indication of a true difference between two groups. This evidence can substantiate Hypothesis H3 and suggest that children who are exposed to educational tools that are enhanced with AI may produce even distinctive and probably better outcomes in terms of cognitive and social development in contrast to the results generated by the children in the traditional learning environments. Hence, the introduction of AI tools to early learning may make a difference in the development of young children.

## **Discussion**

The results of the study demonstrated great and statistically significant correlation between the educational process involving interactive AI tools and the increase in the attention among the children. This confirms the assumption that the AI-assisted learning environment is effectively designed to help students become more focused as a result of time spent in the environment as it stimulates their interest and personalizes the material. Children who used such tools showed increased levels of attention as compared to those who used the conventional methods of learning. This corresponds with the research by (Pai et al., 2024), which notes that attention span is better with AI tools that have gamification and adaptive learning interfaces amongst the learners in primary schools. The findings indicate that interactive characteristics like real-time feedback and multimedia information could be useful to get the attention of children and maintain them on the learning session. These tools can also help teachers in the management of the attention problems as it gives teachers topographical data regarding how students are behaving. The application of AI to the classroom thus appears to be successful in boosting the cognitive attention of children and provides a valuable addition to the traditional teaching that can be useful with students with low intellectual level who will find it challenging to stay engaged in the school routines.

The regression analysis gave additional strength to the fact that the utilization of the adaptive AI platforms had a significant relation to the attainment of improvement in the retention and the recall aptitudes in the children. The students who frequently used these tools performed better on at least some memory-based tasks, which seems to indicate that individualized pacing and repetition strategies provided by the AI system is likely to play an important role in reinforcing cognitive processing. This concurs with the conclusions of the study by (Alghamdi et al., 2025), according to which AI-driven adaptive systems contribute to learning reinforcement on the background of the continuous assessment and revision prompts. This study shows better memory and retrieval ability of learned material by the students who spent more time interacting with the AI platforms due to scaffolding and repetition features of such programs. Since these tools can make a content more difficult or easier according to the performance of the learner on a real-time basis, cognitive overload and the resulting memory consolidation can be reduced.

Moreover, the ANOVA indicated that significantly greater improvement in the development of children who received AI-assisted learning was achieved as compared with the children who studied in conventional classrooms. The results of this included gains in both issues in reading semantics, such as, difficulty solving problems, and issues in social areas, such as, working with peers. The results are consistent with the studies by (Chen et al., 2021), who noted comparable developmental benefits of learners receiving education in AI-enriched environments when working with young learners. The two-way engagement with AI tools, along with aspects of individual feedback, multimedia-hosted content, and real-time evaluation, can possibly provide a more captivating and playful learning experience that young learners could have. Old fashioned classrooms, on the other hand, do not necessarily offer as much one-on-one interaction as a model classroom, because they are limited by the proportion of the number of students to teachers and by stereotype-based timing. The statistically significant differences in the results of the present

research demonstrate the revolutionary capability of AI adoption in primary education. Particularly, these data support the importance of educational stakeholders paying attention to technological solutions that have more than just a basic approach of digitization but rather focus on tools that are intended to accommodate the unique demands and strengths of each learner.

## **Conclusion**

One of the aspects which were contemplated or taken into consideration by this research project was whether it is possible or feasible to use or apply interactive artificial intelligence in the attention, remembering and overall performance in the learning activities of the primary school kids. As was evident in the results, the students studied who actually participated in active practices of using AI-enhanced learning tools had an upper hand in terms of being able to stay focused, remember the information and learn the development of cognition compared to their peers. These tools provided a wide range of learning experiences and instant feedback and encouraging material that served as evidence of the fact that a child was able to stay interested in the work and could know material. The validity of the statistical test and other test helps in supporting the findings that the use of AI tools has had an effect on the good performance of the students learning. The research aims at demonstrating facts that prove that young children can obtain positive results in their learning through the intelligent application of technology. It shows also that there is the necessity to adopt the modern way of teaching that that meets the demand of the modern learner. Following the words, in several words, the study focuses on the idea that with the assistance of artificial intelligence, the work of teachers can be facilitated and the educational process can be made more efficient and enjoyable to learners

## **Recommendations**

1. Include AI Tools in the Curriculum: Incorporating AI-based interactive learning platforms into everyday curriculum approaches at the school will provide the facility with a better chance to capture the attention and memory of the student.
2. Teacher Training: Teachers should also be trained on how to use AI tools and how to change them in accordance with personal needs and needs of students.
3. Regulation appropriate AI Content: Education AI should take into account the development of primary school children to be more involved in them and comprehend the concept.
4. Check Usage Frequency: The school administrations would be required to observe the frequency and efficiency of the use of AI tools to enable continual gains of learning.
5. Promote parental engagement: Parents need to be directed on how to assist in the AI based learning at home to enhance what is taught in school.
6. Investments in the Infrastructure: Both the public and private schools should enhance their technological infrastructure so that every student can have access to AI resources equally.
7. Follow-Up Assessments: Follow up tests should be carried out periodically in order to evaluate the overall impact of AI usage on learning outcomes of students.
8. Promote Universal Access: AI learning tools must be administered to more learners, with a variety of socio-economic backgrounds, so as to reduce the digital learning disparities.

## **Future Implications**

The present research has valuable implications concerning educational practice and policy in the future. Since the findings demonstrated a high positive impact of interactive AI tools on children attention level and memory, the educational system of the future can be more dependent on the AI-based learning and assist students to develop their cognitive abilities at an earliest stage of their

life. The policymakers and education departments could think about implementing AI-integrated learning programs in both public and private schools to enhance the whole learning quality. It is possible to conduct future studies on the diverse effects of different forms of AI tools on different kind of learning; e.g., how creativity learning, problem solving learning and the involvement of emotions are affected by the type of AI tools. Moreover, AI systems could be enhanced to cater to the needs of every child regarding personal learning speed and manner and the process of education could become more personal. The study, in addition, demonstrates the need to carry out studies on the long term impacts of continuing use of AI in learning of learning habits. In the future, there might be collaboration initially between AI developers, psychologists and educators in order to create child friendlier and more effective educational technologies not only to facilitate learning but further emotional and social development of primary school age school-children.

## References

1. Abid, M. B., Afzal, N., Zia, W., Shiekh, M. A., Mahmood, F., & Ghous, M. (2023). Identify Different Challenges Throughout Child Development with Orofacial Clefts. *Medical Forum Monthly*,
2. Ahmad, F., Ahmed, Z., Obaid, I., Shaheen, M., Rahman, H., Singh, G., & Anjum, M. J. (2024). Motivation, Engagement, and Performance in Two Distinct Modes of Brain Games: A Mixed Methods Study in Children. *International Journal of Human–Computer Interaction*, 1-15.
3. Al Saeed, S. M. (2021). The development of vocabulary, working memory and phonological awareness among Kuwaiti Arabic individuals with Down syndrome and typically developing children [Newcastle University].
4. Alghamdi, R. J., Alotaibi, S., Aljuhani, O., & Alkahtani, S. (2025). Associations between physical fitness and executive functions in 10–13 year male children in Saudi Arabia. *Frontiers in Psychology*, 16, 1493206.
5. Bashir, Y., Rashid, S., & Liaqat, S. (2025). The Association between Childhood Behavioral Development and Its Impact on Future Outcomes. *Dialogue Social Science Review (DSSR)*, 3(5), 346-363.
6. Caruso, J. J., & Fawcett, M. T. (2014). Supervision in early childhood education. Teachers College Press.
7. Chen, M., Xu, Q., & Cui, M. (2021). Sleep problems, attention, and classroom learning behaviors of Chinese elementary school children: The moderating role of gender. *School Psychology International*, 42(4), 341-357.
8. Christakis, D. A., Ramirez, J. S. B., Ferguson, S. M., Ravinder, S., & Ramirez, J.-M. (2018). How early media exposure may affect cognitive function: A review of results from observations in humans and experiments in mice. *Proceedings of the National Academy of Sciences*, 115(40), 9851-9858.
9. Fernández, J., Bert, F., & Nicolas-Chanoine, M.-H. (2016). The challenges of multi-drug-resistance in hepatology. *Journal of hepatology*, 65(5), 1043-1054.
10. Hudson, M., Chaudhary, N. I., & Johnson, M. I. (2025). Eye movements and emotional memory images (EMIs): Unravelling the path to adult health from childhood adversity. *Healthcare and Rehabilitation*, 1(3), 100037.
11. Husain, W., Faize, F. A., Urooj, J., & Tariq, R. (2023). Beyond the grades: Measuring teacher's efficacy for the psychosocial grooming of students. *Open Praxis*, 15(1), 60-72.
12. Iqbal, A., Munir, S., & Iqbal, S. (2025). NEUROPSYCHOLOGICAL MARKERS OF DEPRESSION IN CHRONIC PAIN PATIENTS: A PREDICTIVE MODEL FOR EARLY INTERVENTION. *International Journal of Social Sciences Bulletin*, 3(5), 679-686.

13. Jamal-Camden, M. V. C.-S., Sethuraman, W. S. C., Angioletti, C. A.-K. R.-L., Zani, V. R.-M. F.-E., Paris, V., Falso, A. R.-M., & Balconi, D. C.-L. A.-M. (2024). A short review of working memory and attention in depression 7.
14. Jamil, N., Belkacem, A. N., & Lakas, A. (2023). On enhancing students' cognitive abilities in online learning using brain activity and eye movements. *Education and Information Technologies*, 28(4), 4363-4397.
15. Kang, D.-H., Boss, L., & Clowtis, L. (2016). Social support and cognition: Early childhood versus older adulthood. *Western journal of nursing research*, 38(12), 1639-1659.
16. Karapet, H. N., & Misak, A. S. (2024). The Role And Impact Of Artificial Intelligence And Social-Emotional Learning In The Social Pedagogue's Work With Children With Special Educational Needs. *Library of Progress-Library Science, Information Technology & Computer*, 44(3).
17. Khalid, S., & Iraqi, K. M. (2022). Navigating through Covid19-Mothers' Leadership As Catalyst For Sustainable Development Of the Youth Of Pakistan. *Pakistan Journal of Gender Studies*, 22(1), 121-134.
18. Khan, A. M., & Ghazala, N. (2023). Effect of working memory on student's performance at secondary level. *Vfast Transactions on Education and Social Sciences*, 11(4), 21-28.
19. Liu, D., Huang, R., Chen, Y., Adarkwah, M. A., Zhang, X., Li, X., Zhang, J., & Da, T. (2024). *Using Educational Robots to Enhance Learning*. Springer.
20. Liu, H., Qi, Y., Zhang, Y., Yu, A., Chen, Y., Zhang, X., Lou, Y., & Yu, X. (2025). Working memory vs. inhibitory control training: differential and sustained improvements on school-age children's analogical performance and strategy. *Current Psychology*, 1-16.
21. Mahmood, A., Rehman, N., Huang, X., & Zamani, N. (2025). Effect of strategic memory advanced reasoning training (SMART) therapy for enhancing final-year high school students career choices. *BMC psychology*, 13(1), 1-16.
22. Mushtaq, R., Saleem, S., & Subhan, S. (2024). Serial mediation of ADHD symptoms and self-criticism between dysfunctional attitudes and mental health problems in Pakistani University students. *Cogent Education*, 11(1), 2373554.
23. Nasir, S. M., Yahya, N., Yap, K. H., & Manan, H. A. (2025). Executive function deficit in patients with long COVID syndrome: A systematic review. *Heliyon*, 11(3).
24. Nazir, M., & Butt, B. (2025). Non-Verbal Interaction in Down Syndrome Children: An Analysis. *Pakistan Languages and Humanities Review*, 9(1), 374-384.
25. Noreen, S., Bano, H., & Khan, S. I. (2025). An Experimental Evaluation of Multisensory Teaching Techniques on Mathematical Achievement at Primary Education Level. *The Critical Review of Social Sciences Studies*, 3(3), 228-243.
26. Pai, M., Kumar, C., Singh, L., & Singh, P. K. (2024). Adult children's education and older parents' cognitive health in India: examining the pathways of parents' empowered status and active engagement. *Educational Gerontology*, 50(6), 524-549.
27. Papadakis, S. (2021). The impact of coding apps to support young children in computational thinking and computational fluency. A literature review. *Frontiers in Education*,
28. Radesky, J. S., Kaciroti, N., Weeks, H. M., Schaller, A., & Miller, A. L. (2023). Longitudinal associations between use of mobile devices for calming and emotional reactivity and executive functioning in children aged 3 to 5 years. *JAMA pediatrics*, 177(1), 62-70.
29. Rana, J., Luna-Gutiérrez, P., Haque, S. E., Nazif-Muñoz, J. I., Mitra, D. K., & Oulhote, Y. (2022). Associations between household air pollution and early child development among children aged 36–59 months in Bangladesh. *J Epidemiol Community Health*, 76(7), 667-676.



30. Rawson, K. A., & Dunlosky, J. (2022). Successive relearning: An underexplored but potent technique for obtaining and maintaining knowledge. *Current Directions in Psychological Science*, 31(4), 362-368.
31. Sun, J., & Kang, R. (2022). Cool and hot self-regulation predict early achievement in Chinese pre-schoolers. *Early Child Development and Care*, 192(7), 1092-1107.
32. Tariq, R., Aziz, H. F., Paracha, S., Zahid, N., Ainger, T. J., Mirza, F. A., & Enam, S. A. (2025). Cognitive Rehabilitation of Brain Tumor Survivors: A Systematic Review. *Brain Tumor Research and Treatment*, 13(1), 1-16.
33. Zedan, H. S., Bilal, L., Hyder, S., Naseem, M. T., Akkad, M., Al-Habeeb, A., Al-Subaie, A. S., & Altwaijri, Y. (2023). Understanding the burden of mental and physical health disorders on families: findings from the Saudi National Mental Health Survey. *BMJ open*, 13(10), e072115.