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EMPOWERING MINDS: ACTIVITY-CENTRIC MONTESSORI APPROACH AMONG MILD NEURODIVERGENT CHILDREN

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Abstract
The cognitive development is one of the focal areas of the early childhood development, and it involves the processes of perceptions, memory, and understandings. The current research analyzed the effectiveness of Montessori pedagogy in improving cognitive development in children with mild autism using activity-based learning. A quasi-experimental design was employed, use of a cohort of 30 children with mild autism (20 boys, 10 girls) who were recruited in various educational institutions within the Multan, Pakistan. The participants were randomly divided into an experimental group of participants that received Montessori-based intervention and a control group (n = 15 participants per group). Screening was through Childhood Autism Rating Scale (CARS) and cognitive age assessed before and after the intervention with the help of Portage Guide to Early Education (PGEE). It was found that the cognition improved significantly for the group with the Montessori-based activities learning in comparison to the control group with a statistically significant effect. There were concealed substantial disparities in the results of cognitive performance as a matter of the residential locality or socioeconomic status. These observations altogether suggest that Montessori education is an effective education modality that can be used to supplement cognitive performance among children with mild autism hence its incorporation in inclusive education facilities.
Keywords: Montessori approach, cognitive development, activity-based learning, mild autism.

Background of the Study

Children with mild autism spectrum disorder (ASD) often face problems in most areas of cognitive functioning such as attentional control, memory, symbolic understanding and processing information. Such developmental disparities give rise to the need to implement structured, child-centered, and developmentally proper educational measures that can support their learning needs in a satisfactory way. Based on the epistemological approach that is child-centered, Montessori education focuses on autonomy, sensorial exploration and experiential learning. Activity-based learning (ABL) plays a leading role in the given paradigm, as it presupposes children working in their hands-on, interactive assignments instead of passively learning. It is proven that activity-based pedagogies may complement interaction, conceptual learning, and adaptive learning in children with neurodevelopmental problems (Morrison, 2014; Panko et al., 2005).

ABL can offer an ideal channel of strengthening cognitive processes among the children with mild autism by supporting explorations, repetitions, as well as self-directed learning. The design of interventions to be used in children with ASD requires a thorough knowledge of personal learning requirements, responsiveness of instruction, and the best strategies to be applied in communication with children and adolescents. Activity-based strategies also allow the teacher/therapist to design education at the child's current level of development as well as encourage them to engage with learning environment meaningfully. According to developmental perspective, early childhood is a critical period to cognitive development. At the age of five, children have quick developmental progressions in multi-faceted developmental domains, which include the motor, language, cognitive, and socio-emotional developmental domains. According to Piaget, the children that are aged between 2-7 years belong to preoperational stage that is filled with symbolic thinking, embryonic representation, and acquisition of knowledge not based on abstract thinking, but instead concrete experience. Modes of learning that are dependent on the exploration of senses and symbolic means are thus highly relevant at this stage. The Education system of Maria Montessori conforms well to these developmental

imperatives. Her method highlights ordered liberty, material senses and experiential learning spaces that help in cognitive building. New evidence indicates that the learning based on Montessori activities might have unique advantages on children with mild cases of autism, whose cognitive growth during the period of 3-6 years can be boosted using structured and hand-on learning (Ruhl et al., 2021).

Adams et al. (2011) affirm that autistic children can receive Montessori-based education because they are provided with the structure. It is increasingly being appreciated that Montessori education is an effective approach to children with ASD, both because of its nature approach to education, use of sensory explorations, and the focus on learning practical life skills. The fundamental values of the Montessori technique, which are freedom of choice and self-paced learning, are especially useful to autistic children, as they favor the single-style learning. The School in Asperger has been envisioned as a program that is structured but flexible whereby children get to interact with objects and individuals that have different sensory impressions. Also, the focus on fine-motor and coordination would facilitate self-reliance among children, which is the most important concern of autistic individuals. Besides, it has been argued that the Montessori classroom atmosphere promotes the high degree of social interaction, thus, allowing the cultivation of sociolinguistic professional through interaction with peers. The basic characteristics of Montessori education including individualized approach, sensorial activities, and emphasis on practical life all play a role in the effectiveness of the model or program in the academic, social as well as developmental aspects of children with ASD.

The Montessori method is one of the most suitable pedagogical methodologies that can be used to address the special educational needs of autistic children. According to Lane-Barmapov (2016) and Montessori (1912), self-directed, multisensory education is the main focus of this concept of education conveyed through systematically arranged hands-on tasks. The practices based on Montessori enable learners to develop at their own speed, at the same time making them independent and engaged by means of working with tactile materials and visual aids. These recommendations are consistent with evidence-based therapies of autism, such as those proposed by Lovaas (1987) and Schaaf et al. (2014). Despite growing interest in Montessori interventions, limited empirical work has examined their cognitive impact on children with mild autism within clinical and educational settings in Pakistan. The present study therefore investigates the effectiveness of Montessori-based activity learning in enhancing cognitive development among children with mild ASD**.**

Objectives of the Study

- To design and implement an activity-based lesson plans based on Montessori education principles will enhance the cognition of children with mild autism.
- To examine the impact of Montessori education through activity-based learning among children's cognition with mild autism.
- To compare cognitive outcomes between the experimental and control group of children with mild autism following the intervention.
- To assess gender differences among children's cognitive age with mild autism.
- To examine the differences in cognitive outcomes across socioeconomic status.
- To assess the differences in cognitive outcomes between rural and urban areas of children with mild autism.

Hypothesis

H1 Activity based lesson plans based on Montessori education will have the significant positive effect on cognition of children with mild autism.

H2 Montessori education through activity-based learning will predict a significant positive impact on children cognition with mild autism.

H3 There will be a significant difference between the cognitive outcomes of experimental and control group of children with mild autism through Montessori education with activity-based learning.

H4 There will be a significant difference between boys and girl's cognitive age among children with mild autism.

H5 There will be a significant difference in cognitive outcomes between children with mild autism from upper and lower socioeconomic backgrounds.

H6 There will be a significant difference in cognitive outcomes in children with mild autism residing in rural and urban areas.

Significance of the Study

The current study aims to spread the awareness of Montessori education through activity based learning and how age-appropriate education is beneficial for children to enhance their learning, as in Pakistan the concept of age appropriate learning lacks so the current study was doing to show the importance of age appropriated education that how giving age appropriate education to children with mild autism by activity based learning can enhance their cognition. The concept of traditional learning in early childhood needs to be shifted to child activity-based learning as it is more helpful for child to learn by exploring the environment and by doing the work with freedom. The current study wanted to propose the concept of activity-based learning through Montessori as it is helpful for children to enhance their cognition, Parents were asking form the survey questionnaire what they think Montessori Method was effective for

their children or not. The current study was changing the parents' perception towards Montessori education; the high focus was to age-appropriate learning through activities as it reflects the increase in child cognition.

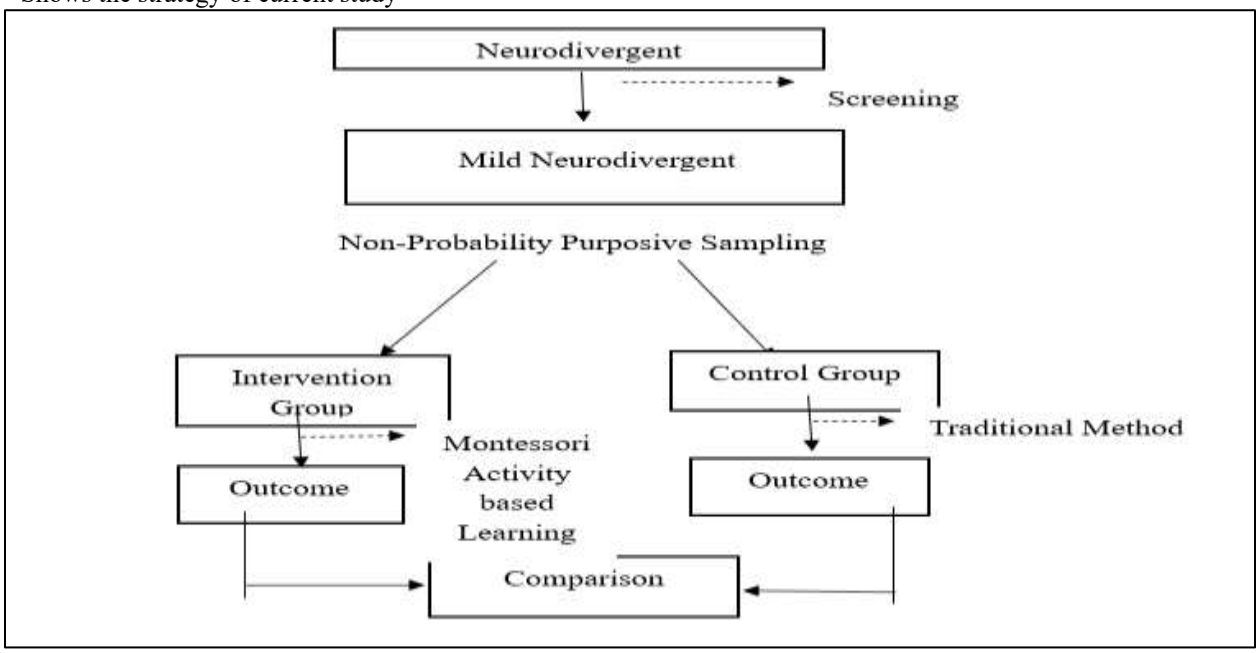
The theory of cognitive development developed by Jean Piaget states that children go through four phases of mental development. His theory is around the definition of intelligence and how kids learn. 18 to 24 month sensory-motor stage: Children grow and learn quickly throughout the sensorimotor stage. Children are continuously picking up new information about how the world functions as they interact with their surroundings. It takes place over a brief period of time and entails a large amount of growth for the cognitive development that occurs throughout this time period. This stage was then broken into several little stages. The final stage of the sensorimotor period is when early figurative thought develops.

Children learn through pretend play during the preoperational stage of toddlerhood (2–7 years) and early childhood, but they have difficulty using logic and comprehending the viewpoints of others. They typically struggle with the idea of consistency as well. Concrete operational youngsters (7–11 years old) they are less ego centric at this time period and they started to thinking about the people thinking and feelings. In the third stage of concrete operational period, kids after all get to know that the thinking and the ideas that they have belongs to them only else thinks, feels, or holds the same viewpoints. The capacity of logical thinking and abstract thinking improve at this stage (7-11 years). At this point, people are able to find out many questions answers around their surroundings what are the science of all this concept. (Kendra & Cherry., 2020). In the current study, we followed Piaget's description of the preoperational stage, during which youngsters start to think metaphorically and acquire objects using words and images. Children at this level are egocentric and they have trouble understanding other people's perspectives. In this study, we investigate the potential benefits of Montessori education for children with specific needs.

Najmussaqib et al. (2022) The goal of the study was to ascertain how much the Montessori Sensorial Training program, when implemented in a different environment, can help children with autism improve their cognitive and adaptive functioning (i.e. special education school system). 30 children with ASD were randomly assigned to the waitlist control condition (n = 15) or the Montessori Sensorial Training intervention condition (n = 15) for pre- and post-testing in a randomized control trial (RCT). When compared to the control group, the intervention group significantly outperformed them in terms of classification, segregation, recognition, ordination, and visual and auditory discrimination. Children who received training outperformed the control group in the areas of communication and self-care. This study offers proof that Montessori Sensorial Training is beneficial for kids with intellectual challenges as well as kids attending regular schools.

Conceptual Framework of Study

Shows the strategy of current study



METHODOLOGY

Research Design

The present study employed a quantitative approach using a quasi-experimental, non-equivalent control group pretest–posttest design. Primary data were collected from two groups: an experimental group receiving Montessori-based activity-based learning intervention and a control group receiving conventional instruction.

The data was gathered using structured assessment tools and questionnaires to assess cognitive outcomes among children with mild autism. Pretest assessments were administered to establish baseline equivalence between the control and experimental groups. A baseline equivalence of the experimental and control cohort was met by pre intervention measures. The post-intervention assessment was also conducted to examine changes in cognitive performance and learning outcomes.

The study design was the one that helped to quantify and compare the differences between pre- and post-intervention in the two groups, hence evaluating the effectiveness of Montessori activity-based pedagogical interventions. Besides that, one of the comparative analyses was conducted to examine gender-specific differences in cognitive age in children, participating in the activity.

Sampling

The population of the current study comprised of children diagnosed with autism spectrum disorder (ASD) enrolled in specialized autism schools and therapy centers in Multan, Pakistan. Non-probability purposive sampling technique was employed to determine the sample where the respondents met inclusion criteria of mild autism and were enrolled in a school. The total sample consisted of 30 children, aged 3 - 6, were equally divided into an experimental and a control group (n = 15 in each group).

Participants

The sample involved children with mild autism who were receiving educational and therapeutic services through Applied Behavior Analysis (ABA) programs and children in remedial education programs in autism therapy centers.

Two groups were formed:

- **Experimental Group:** Children with mild autism receiving the Montessori activity-based learning intervention.
- **Control Group:** The children of autism who were put into remedial programs and were instructed using traditional teaching methods; the severity of autism among the remedial group differed according to institutional placement criteria.

The purposive and non-random sampling were used to select the participants as per the standard educational research methods (Gall et al., 2007).

Setting

The research was conducted in multiple autism therapy centers that are located in Multan, Pakistan. Equivalent institutional settings were used to choose the experimental and control groups because the environmental uniformity was to be maintained. Each participating institution typically enrolled three to four children with mild autism, who were placed in comparable classroom or treatment structures.

For the experimental group, therapists implemented a structured lesson plan based on Montessori principles and activity-based learning strategies. The lesson plans were developed using the Portage Guide to Early Education to ensure age-appropriate cognitive engagement.

In contrast, the control group continued to receive traditional educational instruction routinely practiced within their respective centers. Standardization of the intervention through structured lesson planning enhanced procedural fidelity and contributed to the internal validity of the study.

Activity/ Procedure

After the permission to conducting the experimental study was approved by the institution's directors, 4 institutions were selected to participate in the study. Childhood Autism Rating Scale applied to check the level of autism in children and Portage guide to Early Education was applied to check the cognition level of children. After evaluating the age and level of autism, lesson plan was developed and it was based on activities selected from PGEE. The training was conducted by the researcher that included a script for all therapists to follow when administering the Montessori Method based on activities by a lesson plan. All of the activities were conducted in accordance with the principles of ABA (applied behavior analysis), while also using Dr. Maria Montessori's activity-based learning approach and behavior therapy techniques (prompting, modeling, and reinforcing). Each activity was taught on 10 trials in a one-on-one session with the therapist using the discrete trail training (DTT).

The session lasted between one hour and thirty minutes total session was 30. The Portage Guide to Early Education was used to create a lesson plan for the intervention, and it included directions for all the behavior therapists that adhered to the Montessori Method. These were given to the experimental group and the traditional method of learning to the control group. There was also a script (Montessori principles) for therapists about the implication of the lesson plan in the treatment group. The script for the control group included instructions for guiding the therapist to use their current traditional method. The use of a scripted protocol in all of these measures was also an attempt at improving the fidelity and inter-rater reliability of the constituent groups. Inter-rater reliability refers to the degree to which different observers give similar judgments of one and the same phenomenon (Trochim, 2006). This question recruited thirty students to undertake both pre-test and post-test and also to undertake the one-on-one session.

Data Analysis

The statistical analysis of the data was conducted through SPSS 24. Data was analyzed through Eta square to check the effectiveness of lesson plan based on activity-based learning on children with mild autism. Eta square is known as the measure of effect size which is used mostly in ANOVA models. Independent t test was used to find out the difference between control and experimental groups and Regression analysis was used to find out the impact of Montessori education through activity-based learning among children with mild autism.

RESULTS AND INTERPRETATION

The table of descriptive statistics provides information on the demographic characteristics shown in the table, including mean, standard deviation, frequency, and percentage.

Frequency and Percentage of Demographics

Table 1*Frequency and Percentage of Demographics*

Demographic		Frequency	Percent
Gender	Male	20	66.7
	Female	10	33.3
Age	3	13	43.3
	4	11	36.7
	5	3	10
	6	3	10
Area	Urban	23	76.7
	Rural	7	23.3
Socio-economic status	Lower class	2	6.7
	Upper class	13	43.3
Autism	Mild	30	100

Then the result of inferential statistics is presented which included the results based on the aims and hypotheses of the study.

One-way ANOVA

Table no 2*H1: Effect of lesson plan on child cognition with mild autism*

Scale	Male		Female		*F*(18,11)	*p*	η2
Postcognition	M	SD	M	SD	1.20	.002	0.64
	52.4	94.2	47.6	52.4			

*p>.002

Table indicates that there is significant effect of a lesson plan based on activity-based learning on child cognition with mild autism. F (18, 11) =1.20, p=.002*. Eta square value (0.64) indicates that activity-based learning had a large effect on child cognition. Table 1.1 indicates the value of ETA.

ETA Analysis

Table no 3*Table indicates the value of ETA*

ETA Square	Value	Effect
η2	0.01	Small
	0.06	Medium
	0.14	Large

Linear Regression

Table no 4 *H2: Table indicate Impact of Montessori education through ABL on child cognition with mild autism*

Variables	B	β	SE
Constant	80.87		14.56
X	.82	.39	.37

R^2	.15

Linear regression was conducted to examine the impact of Montessori education on children with mild autism through activity-based learning, the findings revealed that Montessori education has a significant positive impact on children with mild autism through activity-based learning with β = .39, t(28) = 2.24, *p* = .03. Here the β is known as the coefficient variance which cause a change in dependent variable through independent variable.

Independent sample T test

Table no 5 *H3: Table indicates the Difference between experimental and control group*

Scale	Experimental		Control group				Cohen's *d*
	M	*SD*	*M*	*SD*	*t* (*28*)	*P*	
Precognition	39.0	4.06	37.1	5.33	.74	.27	0.40
Postcognition	45.3	6.65	37.8	5.49	1.22	.002	1.22

Independent T test was conducted to check the difference of cognition between experimental and control group before and after the intervention, results show that before intervention there was no significant difference between experimental and control group *t* (28) = .74, *p* = .27. Cohen`s d is known as the effective size between the two variables (0.40) results shows that the effect size was small. After the intervention independent t test was conducted to check the difference of cognition between experimental and control group, there was a significant difference between experimental (*M*=45.3, *SD*=6.65) and control group (*M*=37.8, *SD*=5.49), *t* (28) =1.22, *p*=.002*. Cohen`s d is known as the effective size between the two variables (1.22) result shows that the effect size was large.

Table no 6 *H4: Table indicates the Difference between boys' and girls' cognitive age*

Independent T test was conducted to check the difference between male and female cognition difference

Scale	Male		Female				
Cognition	*M*	*SD*	*M*	*SD*	*t* (*28*)	*p* Cohen`s d	
	39.17	5.66	40.90	4.25	-.500	.363 0.34	

through Montessori learning. Result shows that there was no significant difference between gender on learning Montessori *t* (28) = -.500, *p* = .363. Cohen`s d is known as the effective size between the two variables (0.34) result shows that the effect size was small.

Table no 7

H5: Table indicates the difference between upper- and lower-class boys and girls

Scale	Upper Class		Lower Class				Cohen's *d*
Cognition	*M*	*SD*	*M*	*SD*	*t* (*28*)	*P*	0.37
	38.7	4.20	40.2	5.16	1.87	.183	

Independent T test was conducted to check the difference between upper- and lower-class child cognition with mild autism through Montessori learning. Result shows that there was no significant difference between upper- and lower-class cognition learning with Montessori education t (28) = 1.87, *p* = .183. Cohen`s d is known as the effective size between the two variables (0.37) result shows that the effect size was small.

Table no 8*H6: Table indicates the difference between cognitive age of urban and rural boys and girls*

Independent T test was conducted to check the difference between Urban and Rural areas children cognition

Scale Cognition	Urban		Rural				Cohen's *d* 0.32
	M	*SD*	*M*	*SD*	*t (28)*	*P*	
	39.9	4.47	38.05	4.47	.009	.927	

with mild autism through Montessori learning. Result shows that there was no significant difference between upper- and lower-class cognition learning with Montessori education t (28) = 1.87, p = .183. Cohen`s d is known as the effective size between the two variables (0.32) result shows that the effect size was small. Table 8.1 indicates the value of Cohen`s d.

Cohen`s d value

Table no 9*Table indicates the value of Cohen`s d*

Cohen`s d	values	Effect
d	0.2	Small
	0.5	Medium
	0.8	Large

DISCUSSION

The study's goal was to determine how Piaget theory has affected cognition of children and how they can learn best through activity-based learning rather than Piaget believed that children's cognitive abilities did not fully develop when they were between the ages of three to six. Children with mild autism can learn best through activity-based learning, according to Maria Montessori, who created this educational approach, and their cognition begins to develop at this age, between 3 to 6 (Ruhl et al., 2021) the study's main finding was that children with mild autism can benefit from the Montessori Method's activity-based learning in terms of improving their cognition. The research purpose was to examine the impact of Montessori education on children cognition with mild autism and to examine the hypothesis which were based on impact of Montessori education, difference between girls and boys cognitive age what was the difference between socioeconomic class and areas on child cognition with mild autism. This chapter gives the brief detail about the finding of the thesis and what previous literatures says about the finding of the current study. This chapter also covers the implication of the study, suggestions and recommendation for future studies.

There is a significant effect of lesson plan based on activity-based learning on child cognition, to find out the effect one-way Anova was conducted and ETA Square analysis values indicate that the activity-based learning had a large effect on child cognition. Finding indicates that Pre-testing revealed that children with mild autism have not learned much and their cognition was not improving, but the post rating revealed shows that there was an increase in the child cognition through Montessori method learning, which contradicts the hypothesis that by developing a lesson plan based on activity based learning had a great impact on child cognition to test the hypothesis Eta square was analysed and the finding showed that ABL was effective for children with mild autism. It has also been demonstrated in earlier studies that children learn best while engaging in activity-based learning. Moazzam et al. (2021) carried out an experimental study, this empirical study sought to determine how positive reinforcement affected the social skills of primary-aged autistic pupils. The performance scores on social skills for students taught using an activity-based strategy with positive reinforcement and an activity-based method without positive reinforcement differed significantly on average. The findings suggested that an activity-based approach combined with positive reinforcement may give kids additional opportunities to interact and communicate successfully. Positive reinforcement increased the confidence of kids with ASD in their ability to work in groups, make friends, start conversations, and participate in class at the primary level. The hypothesis was accepted since it is supported by the current investigation and earlier research.

There is a significant impact of Montessori education on child cognition with autism through activity-based learning, to test the hypothesis, linear regression on SPSS version 24 was used. The results show that there was significant impact on child cognition as Montessori Method is helpful for children to learn, this method gives freedom of choice to work. It was hypothesized that Montessori Method through activity-based learning has significant impact on children with mild autism. Therefore, the Montessori Method had a good effect on children's cognition, and as earlier studies also supported the theory, it was accepted, (Smith, 1991). The Stanford-Binet IV and Preschool Language Scale scores of pre-schoolers with autism and their typically developing peers were compared before and after one academic year. Both tests exposed that although autistic children performed at a lower level than their typically developing peers, this gap had been closed as a result of the Montessori Method of activity-based learning, with autistic children's IQs rising by almost 19 points and their language quotients rising by 8 points. The normally developing

peers' IQ score stayed same, but their language score increased by 7.73 points. The evidence is constant in the idea with young children with autism can achieve very substantial developmental advances. The idea that the Montessori Method had a significant impact on improving child cognition was thus supported by earlier studies, and the hypothesis was accepted.

It was also hypothesized that there would be a difference in the experimental and control group cognitive age. Pre and post test was conducted to check the difference between the cognitive age of two groups experimental and control group. To test this, an independent t test was carried out, and the results revealed that there was difference in the cognitive ages of children with mild autism depending on whether they are boys or girls. The purpose of the study, conducted by DOGRU (2015) is to assess the effectiveness of Montessori education, which is provided to children with ASD in order to improve their ability to focus. Six girls and nine boys aged preschoolers who have been diagnosed with ASD (7 of the children have ASD, and 8 have merely ADHD) participated in this study. This study's experimental design includes a control group and a pre-posttest design. In this study, Montessori items such touch boards, sound boxes, binomial cubes, and color tablets are utilized to improve attention level, eye-hand coordination, tactile, visual, and auditory sense development, and acquired distinctiveness. FTFK Children are subjected to attention tests both before and after the intervention. When test results are compared after the training, it is clear that they significantly improved. The outcome therefore shows that Montessori education had a positive effect on kids' learning and cognition, previous literature supports the hypothesis and it was accepted.

It was hypothesized that there was a difference between boys and girls cognitive age so independent t test was conducted but the finding was that there was no difference in children cognitive age weather they are boys or girls with mild autism, there are typically more boys than girls with autism, according to researchers. According to this theory, the (William Mandy, 2017) study found that when the analysis just takes into account the 20 studies, the sex ratio drops to 3.25 males for every girl. The study shows that there was no difference between the boys and girls with autism in their cognitive age; the null hypothesis was rejected because the previous study's results did not support it.

Implication of the Study

The present study contributes to the growing body of knowledge on the effectiveness of the Montessori Method integrated with activity-based learning for children with mild autism. The findings highlight the potential of structured, child-centered, and age-appropriate educational practices in enhancing cognitive development and functional learning skills among neurodivergent learners.

At the classroom level, the study provides practical guidance for educators and therapists by demonstrating how activity-based Montessori lesson planning can support concept formation, engagement, and independent learning. The intervention framework may assist special educators in designing developmentally appropriate instructional strategies tailored to the cognitive needs of children with mild autism.

From a parental perspective, the study may help reshape awareness regarding the importance of age-appropriate, hands-on learning experiences. Parents may better understand how structured activities can be used at home to reinforce cognitive and adaptive skills introduced in therapeutic or educational settings.

Institutionally, the findings underscore the value of incorporating Montessori-based activity learning within special education programs and autism therapy centers. Expanding such pedagogical approaches may enhance the quality of educational services available to children with special needs in Pakistan.

Furthermore, the study highlights the need for continued empirical research exploring Montessori interventions across diverse neurodevelopmental populations, age groups, and educational contexts. Future large-scale and longitudinal studies are recommended to further validate and generalize these findings.

Limitation of the study

- Since the sample size in the current study was small, a larger sample size should be used to determine accuracy.
- The intervention only lasted one month; if it had lasted longer, its effectiveness might have improved.
- Resources were scarce since the Montessori Method was rarely used in Pakistan.
- The sample sizes were not distributed equally according to gender; if they had been, the accurate differences between the groups might have been shown.

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