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Effect of Play-Based Learning on Learning Science and Nature Special Needs Children in Early Childhood Development in Imara Zone, Embakasi West Sub-County, Nairobi County, Kenya

By

[1]Patience Mutheu Mwetu, [2]Dr. Domitilla Mwanzia and [3]Dr. Marwa Muniko

[1]Postgraduate Student, School of Education and Social Sciences, Lukenya University, Kenya
Email of corresponding author: muthewx10@gmail.com
[2]School of Education and Social Sciences, Lukenya University, Kenya
domitillamwanzia@gmail.com
[3]School of Education and Social Sciences, Lukenya University, Kenya
zmuniko@yahoo.com

Abstract
This research project investigated the effect of play-based learning on learning of science and nature among special needs children in the Early Childhood Development (ECD) centers in Embakasi West Sub-County in Nairobi County, Kenya. The study used descriptive survey approach towards 72 teachers of ECDE classes from 18 random schools. Questionnaires were employed as the main method of research, because of its efficiency in collecting broad-based quantitative data from literate respondents in a short period. A pilot study was carried out in two schools beyond the study area to try to test the validity and reliability of the instruments. Content validity was verified by expert review and pilot feedback, whereas reliability was assessed by application of Cronbach's Alpha, resulting in a coefficient of a=.842, indicating good internal consistency. The findings revealed that the positive effect of play-based learning was significant on acquired science and nature concepts by special needs learners. Teachers that used the interactive, multi-sense, and experiential approach to teaching saw engagement and understanding improve in the learners. However, the total successful implementation of play-based strategies was affected by a number of factors including particular lack of training, the lack of learning materials and lack of space for full implementation. The research recommends constant teacher professional development and government support in providing inclusive learning resources to improve the effectiveness of play-based learning. The results provide empirical evidence for the adoption of play-based pedagogues to support cognitive, social and emotional development of special needs children to promote inclusive and effective early childhood education.

Key Words: Play based Learning; Special Needs Children, Science and Nature, Early Childhood Development, Instrument Validity, Reliability

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The Effect Of Play-Based Learning On Learning Science And Nature Special Needs Children In Early Childhood Development In Imara Zone, Embakasi West Sub-County, Nairobi County, Kenya

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1.0 Introduction

Play-based learning has been recognised internationally as being a powerful pedagogue that combines play with academic development, creativity and social growth. In our colleagues' country, Finland, play still remains key in the early education for their education system; they still learn through learning and exploration and through storytelling instead of with a formal teacher (Pyle, Majola, & Pa><a diaris, 2023). NZ's Te Whariki curriculum is play based, culturally responsive, and child-led, and guided on their children's interests and values. Canada has institutionalised play-based kindergarten programs, where teachers are the facilitator between the play and the literacy and numeracy outcomes.

While policy changes in China lead to calls and sankhlocations of parent/child play in the country, academic competition and childrearing pressure stop adherence to keep kid development (Yin et al., 2022). The United States is also confronting barriers with the standardized testing environment reducing time for play in the classroom and focusing on academic measures (Maslin et al., 2023). Similarly, Australia's Early Years Learning Framework gives much weight to belonging and discovery but fails to strike a balance between unstructured play and curriculum and learning outcomes. Globally, although the idea of play-based learning is widely accepted, there remains a more pressing problem in policy alignment, teacher training and cultural attitudes.

In Asia and the Pacific, play-based learning is diverse based on socio-cultural contexts and teacher development. In Indonesia, Mauliya et al. (2020) found limited motivation by teachers and parental expectations restricted the use of playful pedagogies. Similar struggles were found in Palestine and Ireland by Khalil et al. (2022), where traditional educational values favoured structured teaching practices beyond child led exploration. By contrast, in countries such as Australia and Canada, play has been incorporated in policy approaches at institutional level, with institutional support seen as one determinant of success.

However, there is still tension between meeting the standards of the curriculum and giving children the freedom to explore. Studies indicate that teachers tend to misinterpret play as one that lacks productivity as one that is unproductive and developmentally superfluous (Gui et al., 2023). Online learning environments also make it difficult to implement play-based learning, because digital games may have unequal educational outcomes. These differences reveal that, although play-based learning is valued all over the world, its actual realization has to be viewed as strongly context dependent and dependent on professional capacity.

Play-based learning is now firmly established as a key component of early childhood development all over Africa, but its implementation is still characterized by systemic challenges. Countries like Ghana are plagued by insufficient infrastructure, teacher absence, and malnutrition, all of which makes it challenging for people to engage in play (Hassan et al., 2020). But in Ethiopia, Tanzania and Uganda, by matching teacher-training curriculums

and basic education frameworks, play-based practices are less sustainable (Mendenhall et al., 2021). Nigeria's National policy on Education encourages child-centered education, but rote learning is predominant because of lack of materials and teacher readiness. South Africa's National Curriculum Framework advocates for play for children below the age of four, but there remain differences in urban and rural Early Childhood Development (ECD) centres. Botswana's programs have creative play, but there is too much pressure for learning results and too little exploration (Mwinsa & Dagada, 2025). Burundi's ECD centres still focus on rote learning because of cultural beliefs that playing is non-academic (Dobles & Marquez, 2025). On the whole, for all the progress made, African implementation is still patchy, limited by socio-economic and cultural factors.

East Africa has been increasingly interested in incorporating play-based learning driven by competency-based education reform, and internationally. In Ethiopia, Uganda and Tanzania, play-based approaches have slowly been introduced into developing countries' early childhood curricula, although the preparation of teachers is inconsistent (Mendenhall et al., 2021). Professional development programs have developed, but are often not supported by long-term mentorships and institutional support (Hassan et al., 2020). Somalia has employed structured play among internally displaced person (IDP) camps for peace-building where it assists the kids in building emotional stamina and solidarity (Kambutu et al., 2025).

Similarly, the use of play as psychosocial activity in the context of humanitarian projects to associate trauma healing with learning is given in South Sudan (Murtagh et al., 2022). The ECD curriculum provided through teacher training and community engagement in Rwanda has been reformed by UNICEF and Right to PLAY. However, scalability in terms of lack of materials and too many in a classroom still poses a problem (Pyle et al., 2023). Through the example of East African developments, it is possible to see the promise and fragility of maintaining the play-based pedagogy in low-resourced settings.

In Kenya, life skills and work placement centers (.pi) have been identified as one of the important pedagogical tools for experiential, learner-centred learning (Sabo, Kenya Kenya UNICEF, 2023). However, application across public ECD centers is not consistent due to a shortage of resources, large class sizes, and a lack of teacher training (Jaaska et al, 2021). Although the Ministry of Education promotes integration through play, some schools find it difficult to put the policy into practice. Private kindergartens are often more successful because of their better facilities and smaller class size. Teachers often fall back to learning drills for the sake of performance goals at the expense of creative play (Kambutu et al., 2025). However, there is evidence that shows that learners who are engaged in guided play have higher motivation and cognitive performance (Cheung et al., 2022). Play based learning supports the holistic development (social, emotional, and cognitive) of children that is critical for sustainable educational reform. The Kenyan experience shows an unhelpful separation of reality and plan in their classrooms.

Implementation of play-based learning is widely spread throughout the counties of Kenya. In the Imara Zone of Nairobi, ECD centers for low-income communities encounter challenges such as poor facilities, and lack of materials for inclusive play (Jaaska et al., 2021). In Kiambu, directed play is considered to enhance cognitive and social abilities, but in most cases, it runs the risk of being small occurrence due to overcrowding and examination pressure (Mwinsa & Dagada, 2025). The private institutions in Mombasa, Kidogo Centres for instance, do a good job of integrating music and storytelling, but the public schools are behind in this, due to the difference in funding (Heang et al., 2021). Kisumu County has been working with community-based organizations and has enhanced school readiness through

teacher workshops but whether this work is sustainable remains in question (Kambutu et al., 2025). Turkana and Garissa counties have implemented culturally relevant play in mobile schools, although the nomadic lifestyles make it difficult to implement consistently (Duo and Gonquoi 2025). Gui et al (2023) found that educators from Nyeri often mistake playtime as idle time, while traditional games are used to teach literacy by pastoral communities in Kajiado's pastoralist communities. These regional variations point to the disparity of access, training and policy support in Kenya.

Teachers have a central role to play in the effectiveness of play-based learning, one of the roles includes providing interaction with play-based environments and relating play to learning goals through play (Dobles & Marquez, 2025). Their capacity to fashion significant play is reliant on suitable training, mentoring, and expertise on the EE; all of which are essential for shaping positive results in the field of educational programs for toddlers and preschoolers (Pyle et al., 2023). However, many Kenyan teachers define play in terms of unstructured activity and increase the opportunities for emotional and cognitive growth is lost (Maslin et al., 2023). Guided play helps promote creativity, communication, collaboration, and problem-solving (which are skills needed for academic development) (Rappa et al., 2025).

Research has proved that learners prefer to learn when the teacher is seen as a facilitator as opposed to a director, where the learner can be self-directed, curious and reflective in the learning through inquiry (Cheung, H. K., Ng S. K., Verghese A., & Ng K. Y., 2022).However, the lack of monitoring and teacher preparation is still a serious obstacle for classroom implementation. Low material resources and large student-teacher ratios also impose additional limitations on good practice (UNICEF, 2023). School leadership and curriculum clarity play an important role in this regard as well and therefore, capacity building of teachers is an area that needs to be strengthened if play-based learning in Kenya is to achieve its full potential.

Although there is an international and regional evidence of the usefulness of play-based learning, Kenya is still challenged in introducing it into the Cherersos Children Centre (CBC) framework. Misconceptions of what play is, poor resources, and failing to prepare teachers mean that play is not getting successfully implemented in classrooms UNICEF, 2023 There is also limited empirical evidence on the impact of play-based strategies on cognitive development and academic performance in learners with special needs. Thus, the present study was carried out to fill this research gap by exploring the impacts of play-based learning on literacy, numeracy and socio-emotional outcomes of early learners in Imara Zone, Embakasi West Sub-county. It will be able to evaluate the potential for better inclusivity through guided play and the related benefits for engagement and retention with children of different levels of learning needs (Jaaska et al., 2021). By using the insights from the three areas (teachers' practices, learning environments, and learning outcomes), the study will produce evidence-based suggestions as to how we might implement these best practices in CBC. Ultimately, it aims to show quality play that is well supported has transformational power on early learning in Kenya. This contribution will contribute to the policy development, practice and inclusion in early childhood education.

1.1 Statement of Problem

Early Childhood Development (ECD) is the foundation of lifelong learning, specifically children with special needs who need inclusion and conducive teaching methods. Worldwide, play-based learning has been acknowledged as a good means to catalyze cognitive, social,

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and emotional development by familiarizing children to the world through exploration of their own touching and doing (UNICEF, 2023). However, despite this assertion, many of the ECD programs in the developing contexts continue to adhere to teacher-centred approaches that restrict exploration and active participation by the special needs learners (Afolabi & Olayinka, 2022). In Kenya, the competent-based curriculum (CBC) promotes experiential learning approaches and play-based learning for holistic development, but there are still challenges in the implementation of the new curriculum because of lack of effective teacher trainings, adaptation materials, and lack of knowledge about the teaching methods to learners with learning disabilities (Mwangi & Mugo, 2023).

In addition, ECD centres in Imara Zone, Embakasi West Sub-County, have extremely limited space, limited assistive resources and lack of competence in the teachers in managing diversity in learning (Njoroge & Kihara, 2023). As a result, special needs children are often kept out of active participation in science and nature learning experiences and, as a result, may have weak conceptual understanding and lack of enthusiasm. Despite many government initiatives encouraging inclusive education, empirical evidence on the impact of play-based learning on the science and nature learning outcomes for special needs children in this locality is non-existent. The current study therefore aims at investigating the influence of play-oriented learning towards learning in science and nature by special needs children in early childhood development in Imara Zone, Embakasi West Sub-County, Nairobi County, Kenya with the intention of seeking evidence to support inclusive and effective early learning methods.

1.2 Research Objective

To examine the effect of play-based learning on learning science and nature special needs children in early childhood development in Imara Zone, Embakasi West Sub-County, Nairobi County, Kenya.

1.3 Research Question

How does play-based learning affect the learning of science and nature among special needs children in Early Childhood Development centers in Imara Zone, Embakasi West Sub-County, Nairobi County, Kenya?

2.0 Literature Review

According to Ali et. al. (2021), play-based learning in early childhood education supports cognitive, social/emotional development, and is a "natural and engaging way to encourage children to explore science and nature." Children can explore their environment and experiment with different materials and ideas through play-based learning, which helps them develop a better understanding of what happens in nature and scientific concepts (Ali et al., 2021). Through play, children problem solve naturally building their amplitude and rational thinking skills in finding answers to problems and questions based on their research. Play-based learning endorses inquiry-based learning and the scientific method, enabling children to ask questions, make observations and make conclusions (Fleer, 2019). Since children are actively involved in the learning process, and build up meaningful connections, they can retain more knowledge and concepts in play-based learning activities.

Children can understand ecosystems, biodiversity and the importance of environmental conservation, by playing with nature. Play-based learning can help children connect to the real world what they learn in the classroom (Fleer, 2021). Play based learning:

Children are experimenting with nature in a firsthand experience, through gardens, rocks, animals, etc. which will help them to appreciate the natural world more (Ali et al., 2020). Babies are born with a desire to experiment and learn through play and so, they are natural little scientists. In addition to restructuring their brains, they transfer their knowledge to strengthen the skills that will enable them to become active, flexible learners; those skills that they will need throughout their lifetime.

Ernst's (2024) study also questioned the prevalence of use of natural environments. Answers to these questions revealed that teachers believed nature to be important for children's development, but opinions did not reveal the application of natural outdoor settings. Environmental pedagogy, teacher's emotional relationship with nature and the difficulty level that teacher noticed while using natural setting were observed to be significantly correlated with each other and there was a significant correlation between the difficulty of using natural setting and actually using it. The findings are in favour of the learning theory, which states that there is a connection between teachers' beliefs and practice. Ernst (2024) concludes that professional development should decrease the perceived complexity in the use of natural outdoor settings in order to increase teachers' use.

Two domains of knowledge, domain-specific (science content knowledge what kids know about a concept) and domain-general (knowledge related to the cognitive skills needed to understand domain-specific knowledge, like processes or scientific thinking), are aspects of the knowledge domains proposed by the reviews of preschool science education (Trundle & Sackes, 2025). Astronomy (Hannust and Kikas, 2021), electricity (Fleer, 2025), food (Cumming, 2023), digestion (Martins and Teizeira, 2020), natural science (Venville, 2024), force (Hadzigeorgiou, 2022) and matter (Krnel et al., 2015) represent some of the scientific concepts that have historically been addressed in relation to the latter. The latter research has taken a successful domestic approach, by testing children's ability to conceptualize the functioning of things as models for helping them in their day-to-day lives (e.g., Cook et al., 2021; Gelman & Brenneman, 2024; Howitt et al., 2024). The more recent empirical studies of preschoolers (Bulunuz, 2023; Eshach & Fried, 2025; Metz, 2024) focus attention on the preschoolers' general ability of scientific reasoning or scientific thinking. However, these assessments and studies do not provide any information regarding the potential models for teaching science in play-based environments in which scientific thought experiments and play-based science visualizations are used to promote science concept learning.

On the other hand some promising empirical data of the relationships between play, imaginative play and creative cognition in science support the relationship between play and the visualisation of important concepts in science. In addition to youngsters imaging scientific issues while role-playing (Fleer, 2020), the characteristics of wonder (Hadzigeorgiou, 2021; Siry & Kremer, 2021) and curiosity (Blake & Howitt, 2022) have been found. Specifically, it is known that authentic learning of science concepts takes place when teachers role model scientific concepts with children (Fleer, 2024) or introduce scientific challenges during children's play (Fleer, 2021; Fleer & Pramling, 2025). However, these studies do not discuss instructional practices that link play and science imagination.

Although the nature of playful experiences of young children in which to explore their authentic interests (Blake & Howitt, 2022) and their scientific imagination (Hadzigeorgiou, 2021) is still not well understood, children's curiosity when forming the meaning of science (rainbows to clarify concept of light refraction; Siry & Kremer, 2021) and playful ways to satisfy children's curiosity have been studied. The literature that is available suggests that a

deeper knowledge of pedagogy of play for guiding science education in early childhood is needed.

It was recognized that the current science education models in preschool mainly center on the establishment of resource-rich environments for learning (Zhang & Birdsall, 2021), which promote discovery learning (Fleer, 2025; Fleer, 2021). The use of these models takes away many opportunities provided in science learning using play spheres (Tu, 2021). The strategies and methods based on the scientific education of primary school students, where the preliminary research is subjected to learning conditions suitable for children over eight years of age, seem to have been implemented in models of science education by the teachers of early childhood (Fleer, 2021).

Due to the discrepancy in developing competences for the children, they are reluctant to develop scientific questions which could lay the foundation of the investigation (Fleer & Pramling, 2025) and uncertain about mastery of knowledge concerning the scientific constructs (Garbett, 2023), thus making the teachers reluctant to inquiry-based pedagogies (Fleer, 2021). Therefore, there is a need for recognizing other studies that would identify the innovative and existing pedagogical strategies that can contribute to improve the science learning contextualized to the play.

Although curricula present multiple kinds of play models (Pellegrini, 2021) special play models have not been specifically dedicated to developing the understanding of sciences. There is a definition of style of play (or non-play) already available (Lillard, 2021), and there is an abundance of conceptualizations of cross-cultural conceptions of play (Goncu et al., 2021).The closest appropriate coronavirus solution is a coronavirus scheme called Play Worlds. In contrast to majority of conceptualisations of play, such a strategy is characterised by the existence of the instructor in the play of the children and the focus on a problem scenario as a play inquiry as one of the elements of creating a play narrative (Hakkarainen et al., 2023). The present paper used Play Worlds to chart out and examine an example of a science lesson in a play-based also surroundings that will assist teachers leverage their advantages in play pedagogy. Nevertheless, the studies have focused mostly on the development of play narratives for a lengthy duration of time (Lindquist, 2025) in contrast to how science knowledge can be passed down to young children. The peculiarity of Play World is that it offers a pedagogical role for the imagination (Hakkarainen et al., 2023), which is effective in promoting children's imagination in terms of engaging in imaginary gaming (Lindqvist, 2025).

To conclude, play-based learning has grown into an important pedagogical field in early childhood education which focuses on meaningful and interesting activities which can promote the comprehensive development of children which encompasses cognitive, social, emotional and physical development of children (Cheruiyot, 2024; Milteer et al., 2021). It makes children stronger in problem-solving, creativity and communication skills unlike the traditional teaching approach where children learn, navigate and build by trying to tackle specific problem and challenges in a guided and imaginative process (Ahmad et al, 2021; Ginsburg, 2021). It is used in many different contexts around the world including supporting English Language Learners, as well as in the creation of integrations of science education and inquiry-based exploration (Ali et al., 2021; Fleer, 2021).

Although the increasing number of nations with increasing investment in early education are turning out to have positive results, the implementation in the countries themselves is a poorly studied phenomenon with Kenya being one such region (UNICEF, 2021; Swank and Shin, 2025). Issues at the frontline involve conceptualizing what is meant

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by a kind of play-based learning games understand what the teacher are ought to embrace and how to draw the best from research models to suit the cultural environment and the growth of students in special education (Crawford, 2024; Ernst, 2024). Although models such as Play Worlds are promising in terms of improving learning in sciences through a guided imagination and in this regard that we have a gap of the models to valuable and practical transformed outcome in terms of our curriculum experiences in early childhood learning (Hakkarainen et al., 2023; Lindqvist, 2025).

3.0 Research Methodology

3.1 Research Design

This study looked at the impact of play-based learning on learning outcomes of learners with special needs in early childhood development in Imara Zone through the descriptive survey research technique. Abbott and McKinney (2022) said that in survey design, the primary objective is on existing phenomena in relation to circumstances, behavior, attitudes, procedures, links, or patterns. According to Berman et al. (2020), the application of descriptive survey design assisted in establishing linkages between events and suited well for analysis and interpretation of trends and relations. Such a design was appropriate for studies with a large diverse population as in the current study. Since the sample was taken from the population, the researcher was able to collect and analyze data in a systematic way (Berman et al. 2020), which in turn was able to show the relationship between the independent and dependent variables and the effect of the intervening variable.

3.2 Target Population

The study focused on ECDE teachers of the 18 selected schools for the purpose of the study as they were the main stakeholders in adopting play-based learning strategies and in understanding the strategies in schools. There are 4 teachers of ECDE on average for each of the schools giving a total of 72 teachers.

3.3 Sample Size and Sampling Procedures

The researcher applied simple random sampling technique in order to select the teachers of primary schools as the sample for the study. Simple random sampling technique had been used where every teacher had an equal chance of being selected for the study (Rahman et al., 2022).

A sample can be defined as relatively small number of people selected from a population with the purpose of investigation (Mohsin, 2021). A sample of 72 teachers were drawn from the 18 selected schools as part of the study because they were significant stakeholders in terms of schools' although they are the pivotal point in terms of adopting and understanding play-based learning strategies. This sample of 72 was drawn from the target population. To calculate the size of the sample the researcher used the following formula by Slovin at 95% confidence level as follows:

$$n = \frac{N}{1 + N \times e^2}$$

Where:
n = Sample size.
N = Total population
. e = Error tolerance (level).

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There were 19 primary schools in Imara Zone. In this case, the sample size was calculated using Slovin's formula:19/ (1 + 19*0.05^2) = 18. The calculation resulted in a sample size of 18 schools. After randomly selecting these 18 primary schools, the researcher randomly selected four teachers from each, giving a total of 72 participants for the study.

3.4 Research Instrument

Questionnaires were used as the major data collection tool for the study. According to Legal Notes (2018), the definition of questionnaire is the questioner instrument of questionnaires that are the questions made in order to get information from respondents. This method was suitable for the study, because target group was large, they could read, and the time frame for data collection was low (Emerson, 2021). The questionnaire was separated into sections; the first section obtained demographic data, the next 4 sections dealt with the four goals of the study, and the culminating section obtained data associated with the intervening variable.

3.4.1 Pilot Study

The research tool was tried out in two primary schools in Embakasi East. The cross sectional pilot was done to check validity and reliability of instruments. Of course, the schools that participated in the pilot are not considered in the actual study. A pilot sample having similar characteristics of the actual sample was selected from which the survey was to be done. This process was used to recognize and fix any deficiencies of the research tools.

3.4.2 Instrument Validity

Content validity was established by means of a pilot study. The final instruments contained input and recommendations from experts and feedback applied during the pilot study in order to improve the quality of the instrument before the actual investigation. Thus, the data collection instruments were more effective and more in line with the study objectives.

3.4.3 Instrument Reliability

Reliability was estimated by a method of tests. The instruments were administered to the same respondents twice and at a two-week interval between the distributions. The researcher also collected inter rater reliability. In this method, two individuals (raters) separately coded the same collection of items and the level of agreement between their classifications was used as a proxy for reliability (Gwet, 2024). The internal consistency of the research items was analyzed using SPSS and the resulting alpha was obtained. . Table 3.1 presents the Cronbach's Alpha coefficients for the three constructs of the study, based on responses from 72 participants. The results show that all constructs demonstrated acceptable internal consistency, with science and nature (α = .842).

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Table 3.1: Reliability Statistics

Reliability Statistics	Cronbach's Alpha	N of Items
Science and Nature	.842	6

Source: Field Data 2025

Data Collection Procedures

To carry out the research work within the chosen primary institutions located in Imara Zone, the researcher collected the letter of introduction from the School of Graduate Studies, Lukenya University. Besides, permission for the research work was obtained from the National Commission for Science, Technology, and Innovation. The researcher also gave information to the Sub-County Director of Education about the plan to conduct the study in Imara Zone primary schools during the period of the study. Before starting the research design, informed consent was taken from the head teachers and teachers of the schools under research. Thereafter, appropriate dates and times were scheduled so that they would not conflict with class times. The researcher and a research assistant were responsible for administering the questionnaires to the respondents in a personal interview style.

3.5 Data Analysis

The researcher used the version 29 of the statistical package within the software known as Statistical Package for Social Science (SPSS) in the purpose of descriptive statistics, inferential statistics, and presentation of these through the use of pictorial analysis. The questionnaires were coded, data were entered into the statistical package of the software, IBM-SPSS version 29.

Descriptive analysis was applied for continuous variables to summarize the data. Additionally, the use of visuals such as tables, graphs and charts were used for the summary of research findings. Finally, regression analysis was used to determine the relationship between the dependent and independent variables.

4.0 Findings and Discussions

4.1 Demographic Characteristics of Study Population

4.1 .1 Distribution of Children's Ages

Table 4.1 presents the frequency distribution of children's ages. The results indicate that the largest group of children was aged 7 years (38.9%), making it the modal age. A considerable proportion were aged 8 years (25.0%) and 6 years (16.7%). Smaller percentages of children were aged 9 years (13.9%) and 10 years (5.5%). These findings suggest that the study population primarily comprised learners in the middle of their early childhood education phase. Similar distributions have been reported in other studies on play-based learning and special needs, where children between 6 and 8 years form the majority of participants due to being at a critical stage for literacy and numeracy development (Bautista et al., 2018; Siqueira et al., 2021). A study in Nairobi County by Mwangi and Njenga (2022) likewise found that children with special needs in lower primary (ages 6–8) were more engaged with play-based instructional strategies compared to older learners. The consistency between the present findings and prior research reinforces the importance of focusing on middle childhood years when assessing the role of play-based learning in improving educational outcomes for learners with special needs.

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Table 4. 1: Frequency Distribution of Children's Ages

Age (Years)	Frequency	Percent	Valid Percent	Cumulative Percent
6	12	16.7	16.7	16.7
7	28	38.9	38.9	55.6
8	18	25.0	25.0	80.6
9	10	13.9	13.9	94.5
10	4	5.5	5.5	100.0
Total	**72**	**100.0**	**100.0**	—

Source: Field Data 2025

4.1.2 Gender Distribution

Table 4.2 shows the gender distribution of children with special needs who participated in the study. Of the 72 participants, 41 (56.9%) were male, while 31 (43.1%) were female. This indicates that boys slightly outnumbered girls in the sample, a trend often observed in early childhood special needs programs. Similar patterns have been reported in global and regional studies, which consistently find a higher prevalence of boys in special education settings. For instance, males typically account for about 65–75% of learners in special needs education, mainly due to higher diagnosis rates of conditions such as ADHD and autism (Willcutt, 2022; Loomes et al., 2021). Other studies in Sub-Saharan Africa also revealed comparable findings, with boys being disproportionately represented in special needs classes compared to girls (Ngugi et al., 2020). Research suggests this disparity may not only reflect biological and neurodevelopmental differences but also referral and diagnostic biases, where boys' externalizing behaviours are more easily identified while girls' needs are often overlooked (Russell et al., 2021). The slightly smaller gender gap in the current study compared to international figures may therefore be attributed to local contextual factors, sampling size, or variations in teacher referral practices.

Table 4. 2: Gender Distribution

Gender	Frequency (N)	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Male	41	56.9	56.9	56.9
Female	31	43.1	43.1	100.0
Total	**72**	**100.0**	**100.0**	—

Source: Field Data 2025

4.1.3 Distribution of Common Disabilities among Children in Imara Zone

Figure 4.1 reported that the standard conditions among children in Imara were Autism Spectrum Disorder (ASD) (30.6%), Intellectual Disabilities (25.0%), Cerebral Palsy (20.8%), Down Syndrome (16.7%), and other conditions (6.9%). The relatively high proportion of children identified with ASD in this sample (30.6%) was consistent with trends showing rising identification of autism in early childhood settings, notably where screening and awareness have improved (Baio et al., 2018). International surveillance work has documented increasing ASD caseloads among young learners, which is often linked to broader diagnostic recognition and greater referral rather than a sudden change in underlying incidence (Baio et al., 2021).

The 25.0% share of children with intellectual disabilities aligns with meta-analytic evidence that intellectual disabilities constitute a substantial proportion of identified developmental disorders in low- and middle-income contexts (Maulik et al., 2021). The

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presence of cerebral palsy at 20.8% in your sample also reflected known patterns: while the population prevalence of cerebral palsy is lower than that of developmental delay or intellectual disability, school-based and clinic-based samples frequently show substantial representation of CP among special-needs cohorts because motor impairments prompt early referral to services (Oskoui et al., 2023).

Down Syndrome accounted for 16.7% of your sample. Although the population prevalence of Down syndrome is relatively low compared with other developmental conditions, Down syndrome often appears prominently in special needs class cohorts due to visible phenotypic features and earlier identification (World Health Organization, 2021). The "Other" category (6.9%) likely reflected less common or mixed disabilities (e.g., sensory impairments), again matching broader studies that find a long tail of less frequent conditions comprising the remainder of special-needs caseloads (WHO, 2011).

Local studies have reported broadly similar profiles. For example, a Kenyan research of urban special-needs programmes found autism and intellectual disability among the leading diagnoses in enrolled children, mirroring the pattern observed in Imara (Mugo & Karugu, 2021). Differences in exact percentages between your sample and other studies may reflect methodological factors (school- vs. community-based sampling), varying screening practices, and local referral biases (e.g., teachers referring children with more overt or disruptive presentations). Taken together, the Imara distribution is credible in light of both global surveillance data and regional/ local reports, and it underscores the need for play-based and pedagogical strategies tailored to a heterogeneous set of needs—especially ASD and intellectual disability, which dominated the sample.

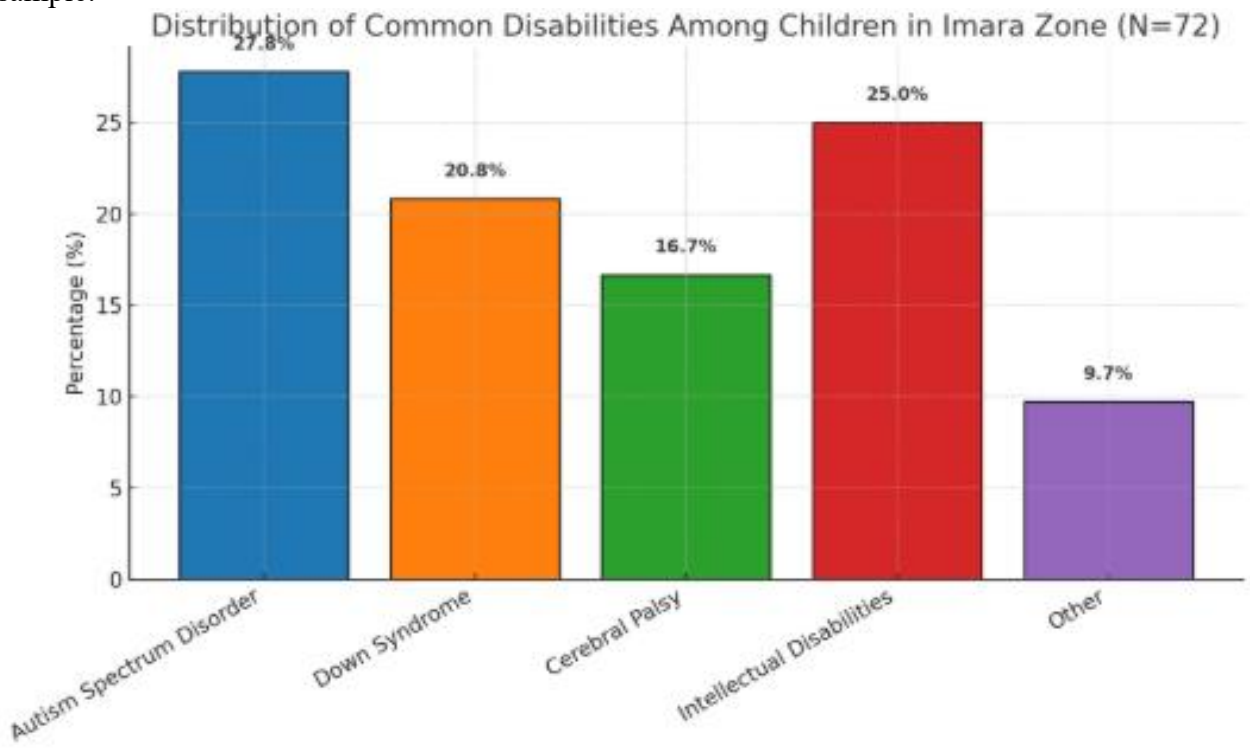

Figure 4. 1: Distribution of Common Disabilities among Children in Imara Zone
Source: Field Data 2025

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4.1.4 Length of Time Children Have Been In Special Needs Education

The results of the study in Figure 4.2 indicate that a significant proportion of children in special needs education had been enrolled for over one year, with the largest group (30.6%) having more than two years of experience. This finding suggests that many children receive sustained support, which is critical for their educational development. Similar trends have been observed in other recent studies. For instance, in the United States, approximately 7.5 million students aged 3–21 received special education services under the Individuals with Disabilities Education Act (IDEA) in the 2022–2023 school year, representing about 15% of all public-school students (National Center for Education Statistics [NCES], 2023). This highlights a long-term commitment to supporting children with special educational needs.

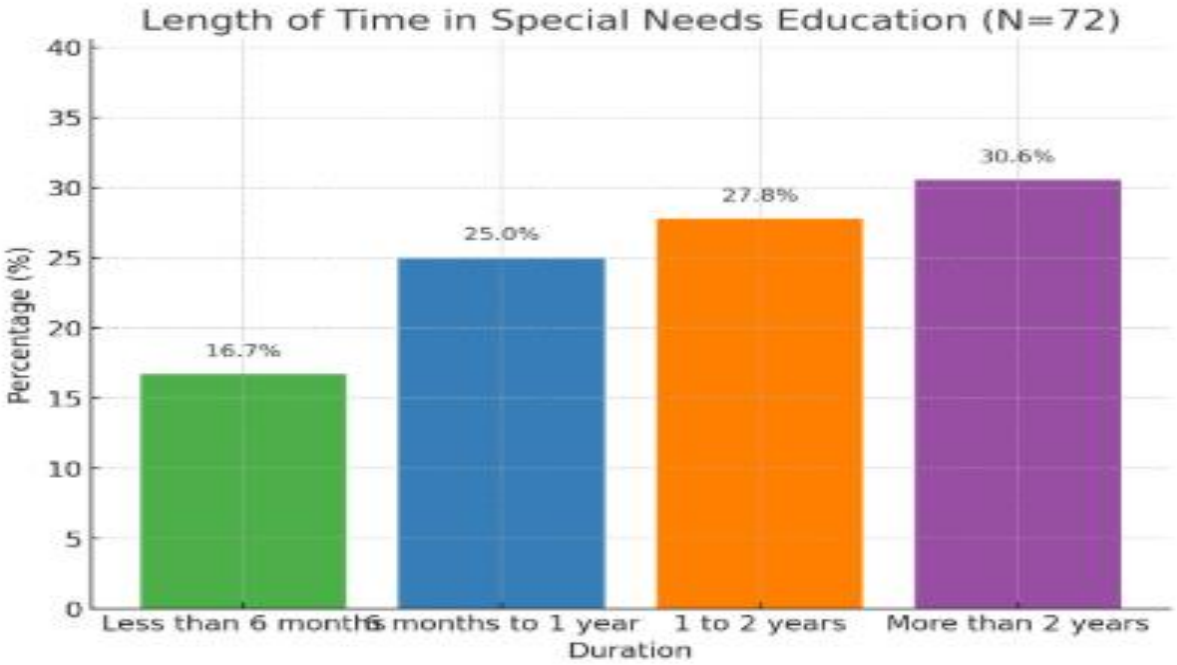

Figure 4. 2: Length of Time Children Have Been In Special Needs Education
Source: Field Data 2025

In England, a report by the Education Policy Institute (2025) revealed that five-year-olds with special educational needs and disabilities (SEND) are, on average, 20 months behind their peers, emphasizing the challenges faced by children with SEND and the importance of prolonged educational support. Similarly, a longitudinal study in Australia found that children with ADHD who were taking medication reported a lower quality of life compared to those who did not, suggesting that medical interventions alone are insufficient and need to be complemented by educational and psychosocial support (Deakin University, 2025).

Collectively, these findings indicate that long-term enrollment in special education programs is common and beneficial. Sustained engagement allows for more comprehensive interventions, which are crucial for addressing the diverse needs of children with disabilities. The current study aligns with these global findings, showing that most children in the sample had received special needs education for over a year, highlighting the importance of continuity in educational support.

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4.2 Effect of Play-Based Learning on Learning Science and Nature

4.2.1 Frequency of Play-Based Activities in Science and Nature Lessons

The study aimed to investigate the frequency with which educators incorporate play-based activities into science and nature lessons. Analysis of the responses revealed that 35% of teachers reported consistently using play-based activities, while 40% indicated they often incorporated them into their classes. A smaller proportion, 20%, reported doing so sometimes, and only 5% stated they never used play-based methods. These results indicate that the majority of educators (75%) regularly integrate play-based learning into science and nature lessons, reflecting a strong recognition of the pedagogical benefits of such activities (See Figure 4.3).

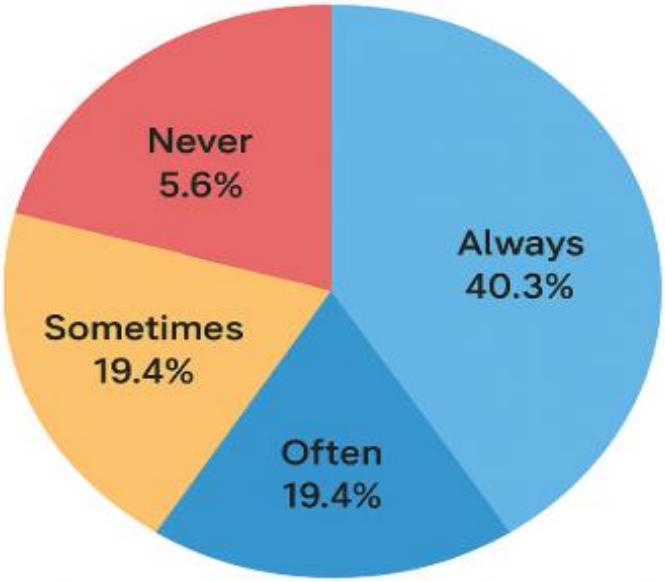

Figure 4. 3: Frequency of Play-Based Activities in Science and Nature Lesson
Source: Field Data 2025

These findings are consistent with recent studies emphasizing the importance of play in early childhood education. Angkur (2025) found that play-based activities encourage curiosity, experimentation, and the development of early scientific reasoning among preschool-aged children. Similarly, Prins (2022) highlighted that play in nature-based settings enhances cognitive and social development. Ramsden et al. (2025) further demonstrated that structured outdoor play interventions improve engagement and learning outcomes in early childhood education. Overall, the survey results align with contemporary research advocating play as an essential component of science and nature education.

4.2.2 The Effectiveness of Play-Based Learning to Understand Science and Nature Concepts

The survey of 72 participants asked about the effectiveness of play-based learning in helping children understand science and nature concepts. The responses were categorized as: Very effective, somewhat effective, Neutral, and Ineffective**.** The results (Table 4.3)indicate that a majority of participants perceive play-based learning as effective in helping children understand science and nature concepts. Specifically, 34.7% rated it as *very effective* and 45.8% as *somewhat effective*, totaling 80.5% of positive responses. Only 15.3% were neutral, and a small minority of 4.2% found it ineffective. The mean score of 3.11 suggests that, on

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average, respondents consider play-based learning to be *somewhat practical* and *very effective*. This supports the notion that incorporating play into science education can enhance children's understanding of natural phenomena.

Table 4. 3: The Effectiveness of Play-Based Learning to Understand Science and Nature Concept

Response	Frequency	Percentage (%)
Very effective	25	34.7
Somewhat effective	33	45.8
Neutral	11	15.3
Ineffective	3	4.2
Total	72	100

Source: Field Data 2025

The findings from the current study, where 80.5% of children rated play-based learning as effective in understanding science and nature concepts, align with a growing body of research emphasizing the benefits of nature-based and play-based learning approaches. A study by Ahern (2021) also shows that nature-based play is a practical approach to implement the concept of STEM in early childhood education, since children can be introduced to scientific principles much earlier than in traditional school. Similarly, a systematic review by Prins (2022) points out that interactions with natural environments produce positive results in the cognitive, socio-emotional, and physical areas of young children. These studies support the assumption that play-based learning, especially in the natural context, can supplement children's understanding of scientific and natural phenomena. The positive images reported in the current study are part of a broader body of literature promoting the need to incorporate play and nature into early childhood education.

4.2.3 Children's Interest In Nature And Science Subjects When Using Play-Based Methods

The survey asked respondents whether they observed increased children's interest in nature and science subjects when using play-based methods. The responses were categorized as follows: Yes, significantly; Yes, somewhat; No change; and No, it decreases**.** The results, as demonstrated in Figure 4.4 below, indicate that the majority of respondents observe a positive effect of play-based methods on children's interest in nature and science subjects. Specifically, 38.9% reported a *significant increase*, and 41.7% noted *some increase*, totaling 80.6% perceiving a positive impact. Only 13.9% reported no change, and a small minority of 5.5% observed a decrease in interest. The mean score of 3.14 suggests that, on average, play-based methods moderately increase children's interest in these subjects significantly. This finding supports the growing evidence that interactive and playful teaching approaches can enhance engagement and curiosity in science learning among young children.

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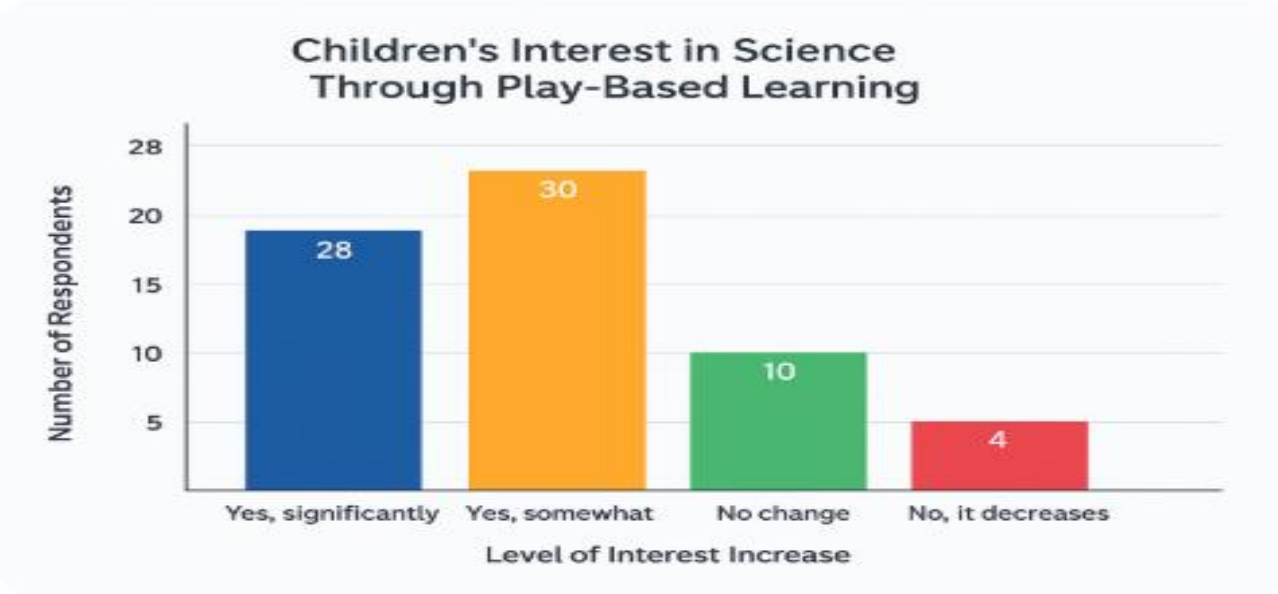

Figure 4. 4: Children's Interest In Nature And Science Subjects When Using Play-Based Method
Source: Field Data 2025

The current study's finding that 80.6% of respondents observed an increase in children's interest in nature and science subjects through play-based methods aligns with recent research emphasizing the efficacy of play in fostering engagement with STEM concepts. A study by Gabrielle Ahern (2021) highlights that nature play is an effective method for embedding STEM concepts in early childhood education, with children engaging with science concepts long before formal schooling. Similarly, a systematic review by J. Prins (2022) indicates that play in nature-based environments contributes positively to cognitive, social-emotional, and physical development in young children. These studies support the notion that play-based learning, especially in natural settings, enhances children's understanding of scientific and natural concepts. Furthermore, a recent article from the National Center for Science Education (2020) emphasizes the role of play in informal learning, noting that various organizations are investigating ways to use play to promote science learning behavior and explore scientific contexts and concepts. This underscores the broader educational community's recognition of play as a valuable tool in science education. Collectively, these studies reinforce the findings of the current research, highlighting the positive impact of play-based learning on children's interest and engagement in science and nature subjects.

4.2.4 Most Effective Play-Based Activity For Teaching Science and Nature

Among the 72 respondents in the present study, outdoor exploration emerged as the most effective play-based activity for teaching science and nature, with 38.9% of teachers selecting it. This preference aligns with recent findings indicating that outdoor learning environments foster children's curiosity, engagement, and conceptual understanding of science. For instance, Kiviranta (2024) noted that outdoor learning provides rich opportunities for experiential inquiry and skill development in early childhood. Similarly, Goldenberg et al. (2024) found that outdoor activities reduced stress and improved children's engagement in

urban schools, while Ramsden et al. (2025) demonstrated that structured outdoor play interventions significantly improved participation and learning outcomes. These results affirm that outdoor exploration creates authentic and hands-on experiences that support children's grasp of scientific concepts.

The second most preferred activity, reported by 27.8% of teachers, was sensory play, such as touching and smelling natural elements. Recent research supports this finding, with Kucirkova and Arredondo (2024) emphasizing that olfactory and tactile experiences foster deeper engagement and memory retention in early learning contexts. Fan et al. (2024) also observed that multisensory approaches enhance both attention and learning efficiency in young children. These studies reinforce the idea that sensory-rich experiences can stimulate children's natural curiosity and make abstract science concepts more tangible. The alignment between these findings and the present study suggests that teachers recognize the value of incorporating multiple senses in learning nature-based content.

Interactive games, such as nature scavenger hunts, were chosen by 20.8% of respondents. This aligns with global evidence that game-based learning is an effective pedagogical strategy for motivating learners and promoting problem-solving skills. Alotaibi (2024), in a meta-analysis, reported that game-based learning has moderate but consistent effects on children's cognitive development and engagement. Similarly, Pisabarro-Marrón et al. (2024) demonstrated that scavenger-hunt-based games promote active knowledge seeking and enhance collaboration among learners. These findings suggest that teachers' preference for interactive games reflects their potential to blend playfulness with structured science learning, thereby fostering both motivation and conceptual growth.

Art-based activities, including drawing animals and plants, were selected by 25.0% of teachers as effective for teaching science and nature. Current research emphasizes the role of arts integration in fostering knowledge construction and social development among young learners. For example, Lauss et al. (2024) found that incorporating art into classroom instruction fostered stronger peer relationships and collaborative learning. Escala et al. (2024) also demonstrated that art-based approaches promote creativity and meaning-making in science education, while Oliver-Barceló et al. (2024) noted that visual representations help children connect abstract concepts to concrete experiences. The current findings support the current literature role, which holds that teachers believe that artistic expression is a way of strengthening scientific concepts.

It seems storytelling was the least popular mode rated as effective by only 13.9% of the respondents, compared to outdoor, sensory, and interactive modes. Mustafa (2024) also stated that digital storytelling increased the motivational and attention level in young children, and Alkilani and Alazaaleh (2025) observed that storytelling leads to the development of language and engagement in classrooms in early childhood settings. Although little research has directly linked storytelling to learning in the sciences, there is evidence that storytelling helps with vocabulary learning and conceptual scaffolding, which in turn indirectly assist in scientific understanding. The comparably reduced preference can be attributed to the propensity of the teachers to prefer more practical methods; however, the literature suggests that storytelling can still be used as a good supplement to the other teaching models.

Altogether, according to the research results, educators belonging to the identified group tend to be very supportive of the practical concept of activity, grounded in experience related to senses and physical activities, as well as interactive games, outdoor adventures, etc. This taste is in line with current international literature that outlines the importance of

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embodied, context-circumstantial, participatory endeavors in building on scientific knowledge amongst young pupils. Though less obtrusive, arts and storytelling are essential supplementary facilitative roles that boost creativity, communicative, and meaning-making in science learning situations. Together, the findings supporting the argument that different play-based methods can have an optimizing effect on children in science and nature are boosted.

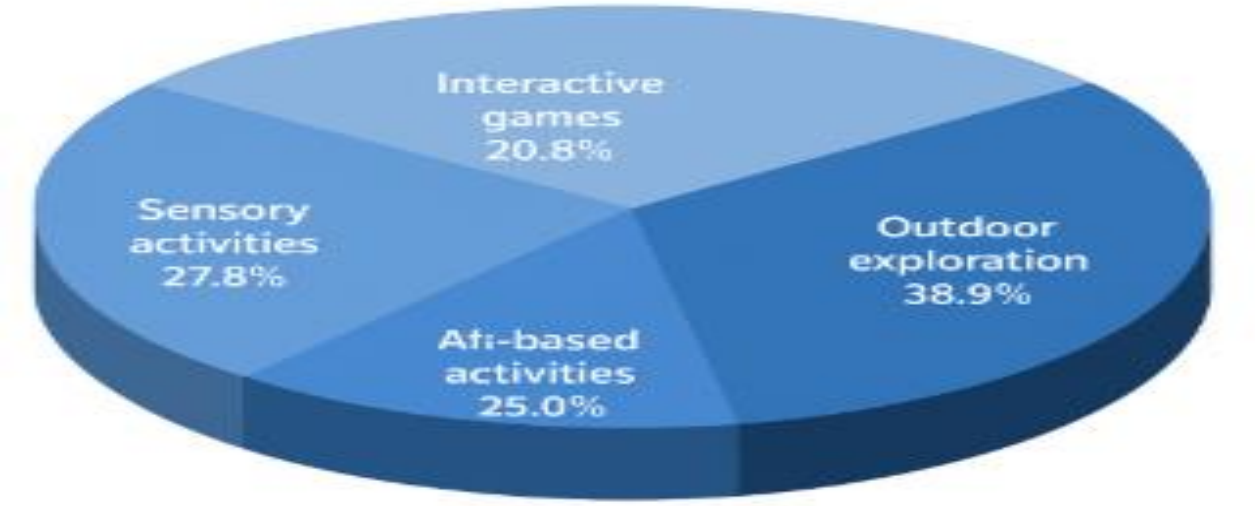

Figure 4. 5: Most Effective Play-Based Activity for Teaching Science and Nature
Source: Field Data 2025

4.2.5 Effect of Play-Based Learning on Children's Ability to Retain Knowledge about Nature and Science

The results of the current study (Figure 4.6) show that the majority of respondents perceived play-based learning as highly effective in enhancing children's ability to retain knowledge about nature and science. Specifically, 41.7% of teachers strongly agreed and 38.9% agreed with this statement, making a combined 80.6% endorsement. Only a minority expressed reservations, with 13.9% disagreeing and 5.6% strongly disagreeing. These findings indicate that teachers overwhelmingly view play-based approaches as beneficial in supporting memory retention and long-term understanding of science and nature concepts.

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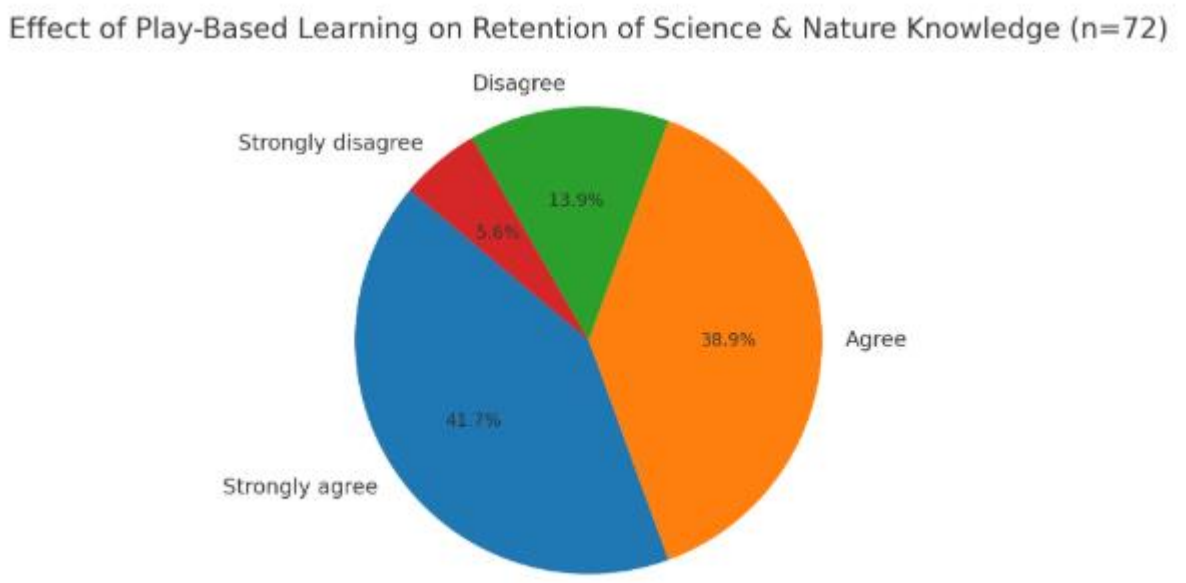

Figure 4. 6: Effect of Play-Based Learning on Children's Ability to Retain Knowledge about Nature and Science
Source: Field Data 2025

This result aligns with global evidence demonstrating that active, experiential, and play-oriented learning improves retention and recall. For example, Alotaibi (2024) reported in a meta-analysis that game-based learning strategies significantly enhanced children's cognitive outcomes, including memory performance. Similarly, Johnstone et al. (2022) found that nature-based early childhood education improved children's engagement and physical activity, both of which contribute to more substantial memory consolidation. These findings mirror the current study, where teachers emphasized the effectiveness of play-based strategies.

Regionally, studies across Africa also highlight the value of play in supporting retention. For instance, Kucirkova and Arredondo (2024) demonstrated that multisensory play, involving touch and smell, not only fostered engagement but also improved long-term knowledge retention among preschool learners. This is consistent with the present finding that sensory activities are considered highly effective in sustaining children's understanding of nature and science. In Kenya, Ayaga and Okaya (2020) demonstrated that outdoor play environments provided opportunities for repeated exposure and practice, which enhanced children's memory of scientific concepts. These regional insights reinforce the idea that play-based methods facilitate deep and lasting learning.

Moreover, studies focusing on storytelling and art-based activities also corroborate the findings of this study, though they highlight different mechanisms. Mustafa (2024) found that digital storytelling improved attention and vocabulary retention, suggesting that narrative approaches scaffold memory even if they are not the primary choice among teachers. Likewise, Lauss et al. (2024) emphasized that art integration helps children connect abstract concepts to concrete representations, aiding recall. These perspectives suggest that while outdoor, sensory, and interactive play dominate teacher preferences, complementary methods such as storytelling and art still play essential roles in knowledge retention.

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In conclusion, the findings of the present study are strongly supported by recent global and regional research, which consistently shows that play-based strategies, particularly outdoor, sensory, and interactive games, enhance children's ability to retain knowledge in science and nature. The relatively high consensus among teachers in this study underscores the universal value of play-based methods as a pedagogical tool for fostering long-term learning outcomes.

4.3 Correlation Analysis

4.3.1 Correlation Analysis between Independent and Dependent Variables

The Pearson correlation analysis (Table 4.4) indicated a strong, positive relationship between play-based learning and science & nature learning among children with special needs ($r = 0.72$, $p < 0.01$). These results suggest that greater engagement in play-based learning activities is associated with higher academic and creative performance among children with special needs.

Table 4. 4: Correlation Matrix

	PlayBasedLearning	ScienceNature
PlayBasedLearning	1	0.72
ScienceNature	0.72	1

r-value (0.72) = correlation coefficient → strength & direction
Significance (p-value) indicated by ($p < 0.01$) or * ($p < 0.05$)
Source: Field Data 2025

4.3.2 Correlation Analysis between Independent Variables and Government Policy

The correlation analysis revealed a moderate, positive relationship between play-based learning and the effectiveness of government policy ($r = 0.45$, $p < 0.05$). Science and nature learning also showed a mild positive correlation with government policy ($r = 0.50$, $p < 0.01$). These findings suggest that higher engagement in play-based learning and learning outcomes is related to a perception of better government policy support for children with special needs.

Table 4. 5: Correlation Matrix

	PlayBasedLearning	ScienceNature	GovPolicy
PlayBasedLearning	1	0.72	0.45
ScienceNature	0.72	1	0.50
GovPolicy	0.45	0.50	1

R-values show the strength and direction of the relationship
Significance: $p < 0.05$, $= p < 0.01$
Source: Field Data 2025

Conclusion

Based on the correlation analyses, several conclusions can be drawn regarding the impact of play-based learning on children with special needs and the role of government policy support. First, the study concludes that play-based learning is strongly associated with improved academic and creative outcomes. Specifically, children who actively engage in play-based activities demonstrate higher performance in science and nature learning ($r = 0.72$, $p < 0.01$)

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and creative learning ($r = 0.69$, $p < 0.01$), while also showing moderate gains in numeracy skills ($r = 0.58$, $p < 0.01$). This underscores the effectiveness of interactive, experiential, and multisensory play methods in promoting holistic learning among children with special needs. Second, the findings suggest that play-based learning contributes significantly to cognitive, social, and creative development. The strong correlations observed indicate that play-based strategies provide an environment where learners can explore concepts, engage in problem solving, and express themselves creatively. These outcomes align with established pedagogical principles emphasizing active learning and individualized support, demonstrating that inclusive, play-oriented approaches can enhance knowledge retention, conceptual understanding, and learner motivation.

Recommendations

Based on the study's conclusions, the following recommendations are proposed: In addressing the application of the learning through play teaching to improve the handing of the education in schools, it is urgently needed that all the learning institutions invest much power in the incorporation of the pedagogical methods in the more fundamental areas of the curriculum or syllabus namely science, numeracy, and creative arts, especially to students with special educational needs. Teachers ought to embrace interactive, multisensory, and experiential teaching techniques to encourage cognitive, social, and innovative learning to ensure that the instructional materials used are attractive and receptive to the profiles of the individual learners.

It should also institutionalize the continuous professional development of educators, focusing on the nuances of effective play-based pedagogies. Scholars who come to the regular training and workshops need to be busy with it. There are several ways through which stakeholders can ensure that learning results are optimized by providing teachers with the necessary competencies required to facilitate, adapt, and design inclusive activities that meet the heterogeneous needs of students with special needs, thereby achieving better results.

Government support and presentation of resources are essential systems for progressive improvements. Education ministries, along with relevant authorities, should intensify the implementation of policies by ensuring that they have multiple learning materials, play equipment, and appropriate infrastructure facilities in early childhood development centres and special needs classrooms. Clearly defined instructions, the regularity of control, and specific assistance are all needed to help teachers implement play-based learning more effectively.

The cooperation between schools, parents, and communities should be encouraged. Schools must reciprocate with students by engaging parents and other community members in ensuring the development of play-based learning at home and in the community. Systematic exercises involving parental instructions and community provisions could also support education and make it more motivational, and lead to the overall development of especially needy children.

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