p-ISSN : 2708-2113 | e-ISSN : 2708-3608

DOI(Journal): 10.31703/gesr
DOI(Volume): 10.31703/gesr/.2024(IX)
DOI(Issue): 10.31703/gesr.2024(IX.II)

www.gesrjournal.com
Global Educational Studies Review
GESR
educating humanity

GESR

GLOBAL EDUCATIONAL STUDIES REVIEW

HEC-RECOGNIZED CATEGORY-Y

VOL. IX, ISSUE II, SPRING (JUNE-2024)

HumanityPublications
sharing research
www.humapub.com
US | UK | Pakistan

Double-blind Peer-review Research Journal
www.gesrjournal.com

Humanity Publications (HumaPub)
www.humapub.com
Doi:https://dx.doi.org/10.31703

Article Title

Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level

Global Educational Studies Review

p-ISSN: 2708-2113 e-ISSN: 2708-3608

DOI(journal): 10.31703/gesr

Volume: IX (2024)

DOI (volume): 10.31703/gesr.2024(IX)

Issue: II Spring (June-2024)

DOI(Issue): 10.31703/gesr.2024(IX-II)

Home Page
www.gesrjournal.com

Volume: IX (2024)
https://www.gesrjournal.com/Current-issues

Issue: II-Spring (June-2024)
https://www.gesrjournal.com/Current-issues/9/2/2024

Scope
https://www.gesrjournal.com/about-us/scope

Submission
https://humaglobe.com/index.php/gesr/submissions

Google Scholar

Visit Us

Abstract

This study was designed to examine the effects of hands-on activities on mathematical concepts at ECE level. The main objective of this study was to increase students' understanding about early mathematical concepts through hands-on activities. Nursery class of Government Primary School Kotkay Puran Shangla KPK was selected for the study as a sample. The nature of the study demanded an experimental research design and one-group pre-test post-test design was used. The test was conducted before teaching through hands-on activities and after to see the effects. In 45 classes the treatment was completed. Pre-test and post-test were the same. The results of paired sample t-test provide evidence of significant differences which show that students' learning of mathematical concepts was raised when taught through hands-on activities. This study recommends emphasizing the importance of hands-on activities while teaching at ECE level.

Keywords: Hands-on Activities, Basic Mathematical Concepts, Early Childhood Education, National Curriculum for ECE

Authors:

Bahram Khan: Elementary and Secondary Education Department, (District Shangla), Government of KP, Pakistan.

Syed Nasir Hussain: (Corresponding Author)
Assistant Professor, Department of ECE & ETE, Faculty of Education, Allama Iqbal Open University Islamabad, Pakistan.
(Email: nasir.hussain@aiou.edu.pk)

Pages: 177-188
DOI:10.31703/gesr.2024(IX-II).18
DOI link: https://dx.doi.org/10.31703/gesr.2024(IX-II).18
Article link: http://www.gesrjournal.com/article/A-b-c
Full-text Link: https://gesrjournal.com/fulltext/
Pdf link: https://www.gesrjournal.com/jadmin/Auther/31rvIolA2.pdf

Humanity Publications (HumaPub)
www.humapub.com
Doi:https://dx.doi.org/10.31703

Citing this Article

18		Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level						
		Author	Bahram Khan Syed Nasir Hussain		DOI	10.31703/gesr.2024(IX-II).18		
Pages		177-188	Year	2024	Volume	IX	Issue	II
Referencing & Citing Styles	APA	Khan, B., & Hussain, S. N. (2024). Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level. *Global Educational Studies Review*, *IX*(II), 177-188. https://doi.org/10.31703/gesr.2024(IX-II).18						
	CHICAGO	Khan, Bahram, and Syed Nasir Hussain. 2024. "Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level." *Global Educational Studies Review* IX (II):177-188. doi: 10.31703/gesr.2024(IX-II).18.						
	HARVARD	KHAN, B. & HUSSAIN, S. N. 2024. Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level. *Global Educational Studies Review,* IX**,** 177-188.						
	MHRA	Khan, Bahram, and Syed Nasir Hussain. 2024. 'Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level', *Global Educational Studies Review*, IX: 177-88.						
	MLA	Khan, Bahram, and Syed Nasir Hussain. "Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at Ece Level." *Global Educational Studies Review* IX.II (2024): 177-88. Print.						
	OXFORD	Khan, Bahram and Hussain, Syed Nasir (2024), 'Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level', *Global Educational Studies Review,* IX (II), 177-88.						
	TURABIAN	Khan, Bahram and Syed Nasir Hussain. "Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at Ece Level." *Global Educational Studies Review* IX, no. II (2024): 177-88. https://dx.doi.org/10.31703/gesr.2024(IX-II).18.						

e-ISSN: 2708-3608 Volume: IX (2024) Issue: II-Spring (June-2024) p-ISSN: 2708-2113

Global Educational Studies Review
www.gesrjournal.com
DOI: http://dx.doi.org/10.31703/gesr

Pages: 177-188 URL: https://doi.org/10.31703/gesr.2024(IX-II).18 Doi: 10.31703/gesr.2024(IX-II).18

Authors:

Bahram Khan: Elementary and Secondary Education Department, (District Shangla), Government of KP, Pakistan.

Syed Nasir Hussain: (Corresponding Author) Assistant Professor, Department of ECE & ETE, Faculty of Education, Allama Iqbal Open University Islamabad, Pakistan. (Email: nasir.hussain@aiou.edu.pk)

Contents

Title

Learning by Doing: Hands-on Activities for Learning Mathematical Concepts at ECE Level

Abstract

This study was designed to examine the effects of hands-on activities on mathematical concepts at ECE level. The main objective of this study was to increase students' understanding about early mathematical concepts through hands-on activities. Nursery class of Government Primary School Kotkay Puran Shangla KPK was selected for the study as a sample. The nature of the study demanded an experimental research design and one-group pre-test post-test design was used. The test was conducted before teaching through hands-on activities and after to see the effects. In 45 classes the treatment was completed. Pre-test and post-test were the same. The results of paired sample t-test provide evidence of significant differences which show that students' learning of mathematical concepts was raised when taught through hands-on activities. This study recommends emphasizing the importance of hands-on activities while teaching at ECE level.

Keywords: Hands-on Activities, Basic Mathematical Concepts, Early Childhood Education, National Curriculum for ECE

Introduction

Early childhood education is a very important phase of life – the beginning of formal schooling where basic literacy and numeracy skills are introduced to the young kids. They commence acquiring knowledge in mathematics far in advance of commencing formal education (Pelatti, Piasta, Justice, & O'Connell, 2014). Young children develop their knowledge and comprehension by observing and actively engaging in daily activities. The acquisition of mathematical comprehension takes place in several environments, including the household, childcare facilities, and during activities such as shopping or visiting the park (Ojose, 2008). Parents and educators have the ability to improve children's early mathematics learning by providing

them with the essential language, meaningful experiences, and opportunities. The significance of mathematics education for children under the age of five is frequently disregarded or misconstrued. Sarama and Clements (2009) propose that teachers must recognize that the scope and depth of suitable mathematics for young children extends beyond what is typically acknowledged. Educators should begin by reflecting on their attitudes and emotions towards mathematics. The emotions are frequently transmitted to children on a subconscious level and will have an effect on their acquisition of knowledge (Mazana et al., 2019). Certain individuals have cultivated exceedingly pessimistic attitudes and had a diminished self-perception regarding their mathematical aptitude. This may be attributed to the inadequate pedagogical methods they encountered, characterized by a focus on memorization and repetitive exercises that prioritized the acquisition of mathematical concepts rather than their comprehension and practical application (Russo & Minas, 2020). Experiencing anxiety about mathematics can result in a sense of unease when it comes to instructing it. Positive encounters with mathematics are frequently associated with educators who rendered it captivating, beneficial, and actively involved youngsters. Our teaching might be influenced by our attitudes and emotions. It is critical that young children receive a strong foundation in mathematics and that we cultivate a favourable attitude toward the subject.

Sadly, according to Gabel (2019), mathematics in early childhood settings frequently receives less attention than literacy. Early mathematics encompasses a wide array of fundamental concepts. Due to their inherent curiosity, children engage in the exploration of these concepts through their interactions with the environment. For instance, young infants engage in mathematical exploration when playing and constructing towers with blocks. During the process of construction, individuals categorize the blocks based on their size and color. They also observe and understand the spatial connections between the blocks. Additionally, they enhance their logical thinking abilities by determining which shapes can be stacked on top of each other, which shapes may cause the tower to collapse, and how to combine shapes to form recognizable items. Preschoolers engage in the activities of counting and comparing things while they engage in play and investigate patterns and shapes. Children need to engage with adults in order to acquire the vocabulary that corresponds to the fundamental mathematical concepts they encounter. Parents and other people can integrate this developmental assistance into their everyday activities. For instance, whether constructing towers or engaging in reading activities with young children, parents can identify and describe various sizes and shapes using appropriate vocabulary. Parents and adults can utilize everyday tasks, like doing laundry, as an educational tool for toddlers and older children. They can encourage youngsters to engage in activities such as counting or sorting items in a laundry basket. Arranging the table for a meal is an additional method to stimulate children's mathematical thinking, which they acquire from infancy until the age of 5.

The first five years of life are a time when young children are naturally curious, and research indicates that this is the ideal time to introduce mathematics to young children because their brains are developing quickly at this age. Early exposure to mathematics fosters the early development of critical thinking and reasoning abilities in kids and lays the groundwork for success in formal education. Infants acquire mathematical knowledge prior to achieving the ability to sit upright. Children observe disparities in amount, analyze the shape and dimensions of objects, and apply rudimentary mathematical principles during play and in various facets of their everyday routines. Mathematics facilitates the cultivation of critical thinking skills and problem-solving abilities in children. Both are crucial for achieving success in both academic and personal spheres, but not all youngsters acquire the necessary mathematical abilities to thrive.

Utilizing hands-on activities has proven to be an effective approach for teaching youngsters science (Witt & Kimple, 2008). As mathematics is a scientific discipline, it can be effectively taught through practical, experiential learning methods. Activities serve as a pedagogical instrument for achieving learning objectives Various pedagogical approaches

can be employed to instruct youngsters in mathematics (Smaldino, 2019). The majority of educators employ traditional approaches, such as delivering lectures and utilizing textbooks, while some may also utilize interactive whiteboards. However, we may educate youngsters in mathematics by engaging them in practical problem-solving exercises. This research study aims to elucidate the efficacy of employing a tactile learning methodology in the instruction of mathematical concepts to students at the early childhood education (ECE) level. This form of education has the potential to improve children's learning and understanding of mathematical concepts at the early childhood education level. Tucker (2014) suggests that in order to improve and facilitate mathematical development, it is essential to have high-quality interactions between educators and children during play experiences.

They utilize impromptu 'teachable moments' to support and enhance children's learning. Extensive research indicates a correlation between early math proficiency and academic achievement. Proficiency in foundational mathematical concepts at an early age is highly indicative of future achievements in both reading and mathematics. Mathematical deficiencies, on the other hand, emerge at an early stage and become apparent when children start kindergarten. Regrettably, children who commence kindergarten with deficient math abilities are prone to lag behind their peers in subsequent grades. Furthermore, the children that exhibit the lowest level of mathematical readiness upon entering kindergarten often originate from minority and low-income backgrounds or are in the process of acquiring English language skills. These considerations indicate that enhancing the future results for all children may rely on introducing them to mathematical concepts at an earlier stage prior to their enrolment in school. Play enhances math learning by fostering a deeper comprehension of mathematics, going beyond just memorization. Promote students' engagement in dialogue, critical thinking, logical analysis, and curiosity as they navigate through problem-solving tasks. Instilling a spirit of inquisitiveness, even for uncomplicated ideas, captivates students in a lighthearted manner. Considering the significant impact Mathematics has on a child's overall performance, this study may be helpful for the teachers and students regarding concepts rather than rote memorization. In the education department of Khyber Pakhtunkhwa, the concept of early childhood education was limited only to one class of nursery (Adna), but for the first time the government has planned to introduce the concept of early childhood education by implementing the ECE curriculum 2020 since 2021. Mathematics is always considered an abstract and non-activity-based subject, although the mathematics concepts are being explained better through the activity method. This study may introduce a better teaching method in which the students are practically involved in a concrete concept that might be logically conceptualized by the students who are taking part in this experiment. This study may further explore the new Avenues instead the traditional teaching methods used in the classroom at the ECE level.

Students at the ECE level learn easily with the help of activities, like the play way method and games. At this level, students learn better through hands-on activities than by observing what they are being taught by the teacher. So, keeping this point in mind, this study was arranged to see the effects of hands-on activities on mathematical concepts at the ECE level. At NC 2020," Domain C: Basic Mathematical Concepts Strand C3: Measurement, Comparison and Ordering" and "Domain C: Basic Mathematical Concepts Strand C4: Geometry & Spatial Sense", this concept is being taught through the memorization method, which is the main problem, and harder in learning. Mathematics is a concrete subject instead of an Abstract concept. So, this problem will be resolved by using hands-on activities as a teaching tool in this study.

Research Methods

The primary objective of the study was to make the students understand early mathematical concepts through hands on activities. The nature of the study was quantitative and experimental. An intact group of students of ECE class (Government Primary School Kotkay, Tehsil Puran, District

Shangla) was engaged so quasi-experimental research design was applied.

Quasi experimental research design in the form of 'one group pre-test post-test' was followed. The research adopted quantitative approach for collecting data. Students for research study were selected according to the previous distribution of school administration during the academic session of the school. This research study involved the following steps:

- Pre-testing and measurement of dependent variables
- Teaching with hands-on activities
- Post-testing and measurement of dependent variable again

To conduct pre-test, I have divided the worksheet in three parts. It was supposed that students cannot read the worksheet, so they face difficulties while attempting it. The researcher created friendly environment with the help of class teacher and then consecutively three days conducted pre-tests to assess their performance. After completion of pre-test, treatment started and taught 10 SLO's within 40 sessions. After treatment post test was conducted consecutively in two days. The session normally starts at Shangla and most of the schools in KPK at the same time, 2nd week of April, I have arranged my treatment in October-November. Before treatment, I have conducted "Pre-test", as the teacher already taught the lessons through their own method. After pre-test, I have started my treatment, instructions based on hands-on activities. The total treatment period was around seven weeks. 40 minutes time were allocated before break as a teaching session.

The instrument to be used for data collection of the study was a worksheet, which was conducted before the treatment and after the treatment. The pre-test and post-test were the same to measure the performance of the students to observe the effect of independent variable i.e. hands-on activities on mathematical concepts which was the dependent variable in this study. Worksheet was developed for the measurement of mathematical concepts at ECE level. Paired sample t-test was applied to examine the difference of learning of students.

Results

The results of the study are as under and presented in tabular form. Ten SLOs were selected from national curriculum and worked on which are as follows:

1. SLO1: Compare quantities
2. SLO2: Use comparative language
3. SLO3: Describe and compare objects using length; weight; height; and temperature
4. SLO4: Sequence events in chronological order
5. SLO5: Recognize and tell days of the week, months of the year
6. SLO 6: Recognize and name 2-D and 3-D shapes and objects
7. SLO 7: Combine shapes to make other shapes
8. SLO 8: Order shapes from smallest to largest
9. SLO 9: Use language related to location
10. SLO 10: Create patterns using concrete materials

In the tables to follow, results are shown in pairs – the results of the pretest and post-test, for example, SLO1 mean(M)s the score of the pretest in SLO1 and SLO1P stands for a post-test score in SLO1.

Table 1

Comparisons / difference of mean(M)s

		Mean	N	Std. Deviation
Pair 1	SLO1	3.77	30	2.029
	SLO1P	11.03	30	2.236
Pair 2	SLO2	5.17	30	1.341
	SLO2P	7.07	30	.828
Pair 3	SLO3	4.43	30	1.675
	SLO3P	7.70	30	2.020
Pair 4	SLO4	1.00	30	.000
	SLO4P	3.43	30	1.633
Pair 5	SLO5	.97	30	1.129
	SLO5P	2.97	30	2.008

Pair 6	SLO6	.37	30	1.829
	SLO6P	14.87	30	8.025
Pair 7	SLO7	.00	30	.000
	SLO7P	1.60	30	1.499
Pair 8	SLO8	4.20	30	1.562
	SLO8P	5.77	30	.568
Pair 9	SLO9	4.83	30	2.119
	SLO9P	3.17	30	1.085
Pair 10	SLO10	4.83	30	2.119
	SLO10P	10.90	30	3.294

- For SLO1, the M. is 3.77 with a standard deviation(SD) of 2.029. In contrast, the paired variable SLO1P has a higher M. of 11.03 and a standard deviation(SD)of 2.236.
- SLO2 exhibits an M.of 5.17, a standard deviation(SD)of 1.341. On the other hand, its paired counterpart SLO2P has a higher M. of 7.07 and a lower standard deviation(SD)of 0.828.
- The M.for SLO3 is 4.43, with a standard deviation (SD)of 1.675. In comparison, SLO3P has a higher M. of 7.70 and a standard deviation(SD)of 2.020.
- SLO4 shows an M. of 1.00 with no standard deviation(SD)(SD = 0.000). Its paired variable, SLO4P, has a higher M. of 3.43, and a standard deviation(SD)of 1.633.
- For SLO5, the M. is 0.97, with a standard deviation(SD)of 1.129. The paired variable SLO5P has a higher M. of 2.97, with a standard deviation(SD)(SD = 2.008).
- SLO6 shows a minimal M. of 0.37, with a standard deviation(SD)of 1.829. Its paired variable, SLO6P has a substantially higher M. of 14.87, a larger standard deviation(SD)of 8.025.
- SLO7 has an M. of 0.00 with no standard deviation(SD)(SD = 0.00). On the other hand, SLO7P exhibits a higher M. of 1.60, a standard deviation(SD)of 1.499.
- SLO8 has a mean(M) of 4.20, and a S.Dof 1.562. Its paired variable, SLO8P, has a higher M. of 5.77, and a lower S.D of 0.568.
- The M.for SLO9 is 4.83, with a standard deviation(SD)of 2.119. In comparison, SLO9P has a higher mean(M).of 3.17, a standard deviation(SD)of 1.085.
- SLO10 exhibits an M.of 4.83, an S.D of 2.119. In contrast, its paired variable SLO10P has a higher M. of 10.90 and a larger standard deviation(SD)of 3.924.

There is considerable variability in the means and standard deviations across different pairs. For instance, SLO6 and SLO6P exhibit a substantial difference in means, with SLO6P having a significantly higher mean compared to SLO6. This suggests a pronounced effect or difference between the conditions represented by these variables. SLO5 and SLO5P have not shown a large difference in means, with SLO5P having 2.008 standard deviation. This could imply possibly indicating less variability in the data points.

SLO4 and SLO4P showcase a stark difference in means, suggesting a notable shift in the measured quantity between the two conditions. The absence of standard deviation in SLO4 might indicate uniformity in the measurements for this particular variable. Several paired variables (SLO1P, SLO2P, SLO3P, SLO4P, SLO6P, SLO7P, SLO8P, SLO9P, and SLO10P) consistently exhibit higher means compared to their respective SLO counterparts. This could indicate that the conditions or treatments represented by the 'P' variables generally result in higher measurements across the board.

SLO7 has a mean of 0.00, indicating that, on average, there is no observed effect for this variable. However, the paired variable SLO7P has a positive mean, suggesting a change in the condition that leads to a measurable effect. The analysis of paired samples reveals varying degrees of difference, consistency, and variability across different conditions. Understanding these patterns can inform further investigations or discussions regarding the factors influencing the measured variables and the implications of these findings in the context of the study.

Table 2

Comparison of M.Scores Percentage of All SLO's Pre-test and Post-test

		M.Percentage	Difference
Pair 1	SLO1	24.22%	
	SLO1P	73.78%	49.54
Pair 2	SLO2	62.91%	
	SLO2P	88.75%	25.84
Pair 3	SLO3	47%	
	SLO3P	86%	39
Pair 4	SLO4	20%	
	SLO4P	67%	47
Pair 5	SLO5	16%	
	SLO5P	49%	33
Pair 6	SLO6	01%	
	SLO6P	57%	56
Pair 7	SLO7	00%	
	SLO7P	38%	38
Pair 8	SLO8	71%	
	SLO8P	96%	25
Pair 9	SLO9	58%	
	SLO9P	79%	21
Pair 10	SLO10	28%	
	SLO10P	64%	36

- In pair 1, the average percent marks for SLO1 (Obtained marks in pre-test for SLO1) is 24.22% and for SLO1P (Obtained marks in post-test for SLO1) is 73.78% while the difference is 49.54.
- In pair 2, the average percent marks for SLO2 is 62.91 and for SLO2P is 88.75% while the difference is 25.84.
- In pair 3, the average percent marks for SLO3 is 47% and for SLO3P is 86% while the difference is 39.
- In pair 4, the average percent marks for SLO4 is 20% and for SLO4P is 67% while the M.difference is 47.
- In pair 5, the average percent marks for SLO5 is 16% and for SLO4P is 49% while M.difference is 33. Although, the M.difference is 33 which shows improvement if we see the overall percent marks of the students which is around about 49% which is not satisfactory, so, this SLO is rarely improved.
- In pair 6, the average percent mark for SLO6 is 01%, and for SLO6P is 57% while the M.difference is 56.
- In pair 7, the average percent marks for SLO7 is 00%, and for SLO6P is 38% while the M.difference is 38., the M.difference is 38 which shows improvement if we see the overall percent marks of the students which is around about 38% which is not satisfactory, also, most of the students are below 50% which is also not satisfactory, so, this SLO is also rarely improved.
- In pair 8, the average percent marks for SLO8 is 71% and for SLO8P is 96% while the M.difference is 25.
- In pair 9, the average percent marks for SLO9 is 58% and for SLO9P is 79% while the difference is 21.
- In pair 10, the average percent marks for SLO10 is 28% and for SLO10P is 64% while the M.difference is 36.
- In pairs 1, 2, 3, 4, 6, 8, 9, and 10, we see well improvement while in pairs 5 and 7, less improvement has been observed.

Table 3

Paired Sample T-test

	Paired Differences	t	df	Sig. (2-tailed)

		Mean(M)	Std. Deviation			
Pair 01	SLO1 - SLO1P	-7.267	2.803	-14.199	29	.000
Pair 02	SLO2 - SLO2P	-1.900	1.626	-6.399	29	.000
Pair 03	SLO3 - SLO3P	-3.267	2.243	-7.978	29	.000
Pair 04	SLO4 - SLO4P	-2.433	1.633	-8.160	29	.000
Pair 05	SLO5 - SLO5P	-2.000	2.133	-5.135	29	.000
Pair 06	SLO6 - SLO6P	-14.500	8.237	-9.642	29	.000
Pair 07	SLO7 - SLO7P	-1.600	1.499	-5.845	29	.000
Pair 08	SLO8 - SLO8P	-1.567	1.455	-5.899	29	.000
Pair 09	SLO9 - SLO9P	1.667	2.040	4.475	29	.000
Pair 10	SLO10 - SLO10P	-6.067	2.766	-12.013	29	.000

- The M.difference B/W SLO1 and SLO1P is -7.267, with a standard deviation(SD)of 2.803. The t-test indicates a statistically significant difference (p-value = 0.000), suggesting that the conditions represented by SLO1 and SLO1P are significantly different.
- The M.difference for SLO2 and SLO2P is -1.900, with a standard deviation(SD)of 1.626. The t-test is highly significant (p-value = 0.000), showing a positive difference B/W the paired samples.
- The M.difference B/W SLO3 and SLO3P is -3.267, with a standard deviation(SD)of 2.243. The t-test is statistically significant (p-value = 0.000), signifying a notable difference B/W the two conditions.
- SLO4 and SLO4P exhibit an M.difference of -2.433, with a standard deviation(SD)of 1.633. The t-test is highly significant (p-value = 0.000), showing a positive difference B/W the paired samples.
- The M. difference for SLO5 and SLO5P is -2.000, with a standard deviation(SD)of 2.133. The t-test is statistically significant (p-value = 0.000), suggesting a significant difference B/W the conditions.
- SLO6 and SLO6P show a substantial M.difference of -14.500, with a standard deviation(SD)of 8.237. The t-test is highly significant (p-value = 0.000), showing a positive difference B/W the paired samples.
- The M.difference B/W SLO7 and SLO7P are -1.600, with a standard deviation(SD)of 1.499. The t-test is statistically significant (p-value = 0.000), suggesting a significant difference B/W the conditions.
- SLO8 and SLO8P exhibit an M.difference of -1.567, with a standard deviation(SD)of 1.455. The t-test is statistically significant (p-value = 0.000), showing a positive difference B/W the paired samples.
- The M. difference for SLO9 and SLO9P is 1.667, with a standard deviation(SD)of 2.040. The t-test is statistically significant (p-value = 0.000), showing a positive difference B/W the conditions.
- SLO10 and SLO10P show an M.difference of -6.067, with a standard deviation(SD)of 2.766. The t-test is highly significant (p-value = 0.000), showing a positive difference B/W the paired samples.

In all pairs, the p-values are very low (all < 0.05), indicating that the differences between the means of the paired samples are statistically significant. The negative mean differences in most pairs suggest that the first variable in each pair tends to have lower values than its paired sample. The wide confidence intervals in some pairs (e.g., Pair 6) indicate variability in the differences, emphasizing the importance of considering the range of possible effect sizes. In summary, the paired sample t-tests provide evidence of significant differences between the paired samples, shedding light on the variations in measurements under different conditions or treatments.

Discussion

The purpose of the study was to analyse the effects of hands-on activities on mathematical concepts at ECE level. The study aimed to reveal to what extent the mathematical concepts is affected while teaching through hands-on activities. Hands-on activities are the activities in which children physically move means through these activities children learn by experiences. The findings of this study revealed that hands-on activities played a vital role in student's achievement. They learn conceptually. These findings were supported by previous research of Arnas (2020), who indicated in his research that students of Early grades better learn through activities. Also, these findings were supported by Abdula and Cairns (2021), according to his

research, there was a strong and positive correlation between early numeracy activities and skills and mathematical attitudes, engagement, and achievements. The findings of this study revealed that there is considerable variability in the means and standard deviations across different pairs. This suggests a pronounced effect or difference between the conditions represented by variables SLO and SLOP. The t-test indicates a statistically significant difference suggesting that the conditions represented are significantly different. The correlation coefficient suggesting a positive but weak correlation. This means that hands-on activity strategy has a significant effect on mathematical concepts. The findings of the study is in line with the findings of some earlier studies on the positive effect of hands-on learning strategy with respect to children's achievement. The study conducted by Case, Harris and Graham (2012) provide basis for the present study.

The finding of the study indicating that the t-test is highly significant indicating a significant difference between the paired samples. The correlation coefficient is close to zero indicating a very weak correlation. Also, the finding of the study indicate that the t-test is statistically significant signifying a notable difference between the two conditions. A correlation coefficient suggests a weak positive correlation. In the light of these findings, it is stated that teaching through hands-on activities effects positively mathematical concepts. Teaching through hands-on activities results better because in this approach students are not passive. The study by Park (2012) found support for these findings from previous studies conducted by Copple and Bredkamp (2009). It emphasizes the importance of teachers designing the physical setting of the learning environment in a way that is culturally and developmentally appropriate, based on continuous observations. In addition, the instructor requires developmentally suitable resources, thoughtful activity ideas, explicit instructions, and focused attention. According to the study conducted by Salami in 2014, using a hands-on/minds-on activity-based technique improved the subject matter knowledge of pre-service primary mathematics teachers more effectively than the standard strategy. In a separate study conducted by Inan and Taskin (2015), it was discovered that activity stations and projects, when accompanied by suitable teacher assistance, establish a light-hearted environment in which children can actively and joyfully participate in mathematics. This work was additionally funded by Julyan and Duckworth (2005). They suggest that creating a playful setting is the most effective way to encourage youngsters to communicate their emotions and alleviate the inherent frustration that comes with building their own understanding. A separate study demonstrated that certain individuals considered the integration of storytelling and hands-on activities to be significant, while others contended that hands-on activities alone were useful without the inclusion of narratives (Wallen, 2017). Other researches have demonstrated that hands-on learning yields greater mean scores compared to those exposed to conventional methods. Furthermore, there is a substantial disparity in the average score of kinesthetic learners who were taught numerical work using hands-on learning compared to kinesthetic learners who were taught using the conventional teaching approach. Noreen and Rana (2019) notes that in most Pakistani classes that employ traditional teaching methods, the focus is primarily on the teacher rather than the learner. Research findings indicate that students exhibit subpar performance, particularly in numerical disciplines such as mathematics (Ashraf, 2019). Based on the existing studies and our findings it was concluded that through hands-on activities, mathematical concepts may improve well.

Conclusions

It is concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is highly significant indicating a significant difference between the paired samples. The correlation coefficient is close to zero indicating a very weak correlation.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through

paired sample t-test and paired sample co-relation. The t-test is statistically significant signifying a notable difference between the two conditions. A correlation coefficient suggests a weak positive correlation.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is highly significant indicating a significant difference between the paired samples. The correlation coefficient is not provided, possibly indicating a lack of variability in one of the variables or a constant relationship. Further investigation into this pair is needed.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is statistically significant suggesting a significant difference between the conditions. A correlation coefficient indicates a week correlation between SLO's. The p-value suggests that this correlation is not statistically significant.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is highly significant indicating a significant difference between the paired samples. A correlation coefficient indicates a weak negative correlation. The p-value suggests that this correlation is not statistically significant.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is statistically significant suggesting a significant difference between the conditions. The correlation coefficient is not provided, possibly indicating a lack of variability in one of the variables or a constant relationship. Further investigation into this pair is needed.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is statistically significant indicating a significant difference between the paired samples. The correlation coefficient indicating a moderate positive correlation. Moreover, the p-value suggests that this correlation is statistically significant.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is statistically significant indicating a significant difference between the conditions. A relatively strong positive correlation coefficient suggests a moderate positive relationship.

It is also concluded that result of post-test for this SLO is better than pre-test which shows better performance while teaching through hands-on activities. Not better result only, it is also observed that student's confidence level also enhances when we teach them through hands-on activities. The performance of the students in both tests shown through paired sample t-test and paired sample co-relation. The t-test is highly significant indicating a significant difference between the paired samples. The correlation coefficient indicating a strong positive correlation. The p-value indicates that this correlation is statistically significant.

Recommendations

Based on the findings of the study, following recommendations are made:

1. Students should be exposed to hands-on activities strategy since the findings of the study indicate that it has a facilitative effect on their learning in mathematical concepts.

2. Students of all genders should be introduced to the hands-on activity's strategy, since they all saw considerable benefits from this instructional approach.
3. School development program must implement in schools, emphasizing the importance of hands-on activities.
4. Positive reinforcement in hands-on activities can motivate the children to practice self-management skills. Parents must acknowledge and celebrate children's effort and progress in self- management.
5. Government must provide goods/equipment's for the children through which they can learn conceptually.

References

Balala, M. M. A., Areepattamannil, S., & Cairns, D. (2021b). Investigating the associations of early numeracy activities and skills with mathematics dispositions, engagement, and achievement among fourth graders in the United Arab Emirates. *Large-scale Assessments in Education*, *9*(1). https://doi.org/10.1186/s40536-021-00106-4
Google Scholar WorldCat Fulltext

Oğul, İ. G., & Arnas, Y. A. (2020b). Role of home mathematics activities and mothers' maths talk in predicting children's maths talk and early maths skills. *European Early Childhood Education Research Journal*, *29*(4), 501–518. https://doi.org/10.1080/1350293x.2020.1858128
Google Scholar Worldcat Fulltext

Ashraf, A. (2019). Effect of Hands-on Learning and Academic Achievement of Kinesthetic Learners in Number Work in Pre-primary Schools in Faisalabad District of Punjab Province, Pakistan. *Asia-Africa Journal of Education Research*, *1*, 68-85. https://journals.iapaar.com/index.php/aajer/article/download/43/43
Google Scholar Worldcat Fulltext

Case L. P., Harris K. R., & Graham S. (2012). Improving the mathematical problem solving skills of students with learning disabilities: Self-regulated strategy development. *Journal of Special Education*, 26, 1–19. https://doi.org/10.1177/002246699202600101
Google Scholar Worldcat Fulltext

Duckworth, E. R., & Julyan, C. (2005). A constructivist perspective on teaching and learning science. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (2nd ed., pp. 61–79). Teachers College Press.
Google Scholar Worldcat Fulltext

Gabel, S., Guhl, D., & Klapper, D. (2019). P2V-MAP: Mapping market structures for large retail assortments. *Journal of Marketing Research*, *56*(4), 557–580. https://doi.org/10.1177/0022243719833631
Google Scholar Worldcat Fulltext

Inan, H. Z., & Inan, T. (2015). 3Hs Education: Examining hands-on, heads-on and hearts-on early childhood science education. *International Journal of Science Education*, *37*(12), 1974–1991. https://doi.org/10.1080/09500693.2015.1060369
Google Scholar Worldcat Fulltext

Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2019). Investigating students' attitudes towards learning mathematics. *International Electronic Journal of Mathematics Education, 14*(1), 1-25.
Google Scholar Worldcat Fulltext

Noreen, R., & Rana, A. M. K. (2019). Activity-Based Teaching versus Traditional Method of Teaching in Mathematics at Elementary Level. *Bulletin of Education and Research, 41*(2), 145-159. https://files.eric.ed.gov/fulltext/EJ1229426.pdf
Google Scholar Worldcat Fulltext

Ojose, B. (2008). Applying Piaget's Theory of Cognitive Development to Mathematics Instruction. *The Mathematics Educator, 18,* 26-30. https://files.eric.ed.gov/fulltext/EJ841568.pdf
Google Scholar Worldcat Fulltext

Park, Y.J. (2012). A Preschool Teacher's Action Research Using a Combination of Hands-On Manipulatives and Computer Software to Help Preschoolers Understand Number Concepts. *Asia-Pacific journal of research in early childhood education, 6*, 85-117.
Google Scholar Worldcat Fulltext

Pelatti, C. Y., Piasta, S. B., Justice, L. M., & O'Connell, A. (2014). Language- and literacy-learning opportunities in early childhood classrooms: Children's typical experiences and within-classroom variability. *Early Childhood Research Quarterly*, *29*(4), 445–456. https://doi.org/10.1016/j.ecresq.2014.05.004
Google Scholar Worldcat Fulltext

Russo, J., & Minas, M. (2021). Student Attitudes Towards Learning Mathematics Through Challenging, Problem Solving Tasks: "It s so Hardin a Good Way." *Lnternational Electronic Journal of Elementary Education*, *13*(2), 215–225. https://doi.org/10.26822/iejee.2021.185
Google Scholar Worldcat Fulltext

Salami, I. A. (2014). Hands-on/mind-on activity-based strategy: The effect on preservice teachers' subject matter knowledge in a primary mathematics methods course. *South African Journal of Education*. https://hdl.handle.net/10520/EJC156760
Google Scholar Worldcat Fulltext

Sarama, J. & Clement, D. H. (2009). *Early childhood mathematics education research: Learning trajectories for young children.* Routledge.
Google Scholar Worldcat Fulltext

Smaldino, P. E. (2019). The evolution of two types of play. *Behavioral Ecology, 30*(5), 1388-1397.
Google Scholar Worldcat Fulltext

Tucker, K. (2014). *Mathematics through play in the early years.* SAGE Publications Limited.
Google Scholar Worldcat Fulltext

Witt, S. D., & Kimple, K. P. (2008). 'How does your garden grow?' Teaching preschool children about the environment. *Early Child Development and Care*, *178*(1), 41–48. https://doi.org/10.1080/03004430600601156 Google Scholar Worldcat Fulltext