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EFFECT OF SCIENCE ACTIVITIES ON PRE-SCHOOLERS' CREATIVE THINKING: AN EXPERIMENTAL STUDY

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ABSTRACT
The current experimental study aimed to investigate the effect of science activities on pre-schoolers' creative thinking. The researchers used one-group pretest-posttest designs in the present investigation. It was a 16 weeks experimental study in which pre-schoolers were taught using science activities based on an activity-based teaching method. From the 24 study participants, the data was collected using the Torrance Creative Thinking Test (TCTT) before providing intervention (pre-test) and after completing the treatment (post-test). Data were analysed using the paired sample t-test at the alpha level of .05. The findings of the study revealed that results in the post-test were significantly higher than the pre-test for TCTT fluency, originality, elaboration, the abstractness of labels, premature closure, overall figure, overall creative strength, and overall creative thinking. Based on the study findings, the researcher recommended that pre-school teachers develop and use science activities to enhance the creative thinking of the pre-schoolers.
Keywords. Creative thinking, science activities, fluency, Torrance creative thinking test

INTRODUCTION
Schools for very young children, such as those offering pre-school, kindergarten, and practicum classes, are collectively called "pre-schools." The pre-school education curricula have been designed to give children a well-rounded education (Ellis et al., 2022). The aim is to ensure that children reach their full potential in terms of their physical, emotional, social, and intellectual development to become independent and prepared for elementary school. Children's first formal educational experiences often occur during pre-school (Iruka et al., 2020). A child's early years are crucial for forming their fundamental skills and sense of identity, both of which will shape their future growth and development (Feldman, 2020). The standard of education and accessibility of chances is crucial at this point. Children in pre-school need stimulating and safe learning environments that promote growth across the board (Koen et al., 2021).

Children's creativity fosters development in their emotional, linguistic, intellectual, and physical capacities. The ultimate level of human success is creativity, which is the culmination of all other mental functions and creative production (Miller, 2022). Developing children's creativity and imagination is a fundamental goal of early childhood education. The pre-school curriculum did not include creativity as a separate subject area. The curriculum, however, is built on the premise that imagination is essential (Dere, 2019). Children have varying learning requirements and learning styles. Therefore, they must be given opportunities to express themselves in ways that are tailored to them. Appropriate openings must be made available to make this possible. The planning process as a whole should encourage inventiveness. Thus, pre-school teachers must grasp the concept of creativity (Cheung et al., 2019).

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Creative thinking leads to the development of fresh concepts (Teodoridis et al., 2019). These novel concepts are fused with preexisting ones to create an innovative new whole. Creativity is crucial to any nation's growth and self-sufficiency (Buheji et al., 2020). It is also found that creative thinkers are needed to address the perennial issues that are a product of the bleakness of our current situation. Therefore, it is essential to encourage children's creative potential. The creative class is tasked with reworking the economy so that everyone can share in the fruits of its members' ingenuity (Mutibwa, 2022).

Creativity is the capacity to demonstrate new or different forms of expression or thought. It's the process by which an individual comes up with novel ideas and produces new things on their initiative (Shao, 2019). Every person has a unique creative style and unique creative processes. Children's pre-schools should have access to age-appropriate learning strategies and a variety of high-quality materials to facilitate the development of their creative potential. Setiawan (2017) states that all of the abilities under "divergent thinking" constitute creativity. It has been determined that fluency, adaptability, originality, and elaboration fall under these classes. Prolific thought production and an abundance of related ideas define fluency. Perspective shifts allow for more adaptability in the face of challenges. When you're creative, you come up with new and exciting thoughts. To elaborate is to provide further specifics about the latest information.

Many believe creativity can help them overcome problems here and now and in the future. The world is constantly evolving, and that's just the way it is (Ershadi & Winner, 2020). The ability to think creatively is often regarded as a crucial 21st-century skill because it plays a fundamental role in coping with change. Humans have a long history of being innovative, using materials like stones and wood to fashion implements that have made their lives easier (Kumpulainen et al., 2020).

As we head towards a future of fast social and scientific changes, creative thinking has assumed centre stage in human development (Slåtten et al., 2020). Early childhood education that fosters children's creative thinking and imagination offers a solid groundwork upon which they can construct their lives and the worlds beyond (Ernst & Burcak, 2019). Curriculum design and teachers' daily interactions with students have the power to either inhibit or foster students' imaginative capacities (Jahnke & Liebscher, 2020). Therefore, teachers need to set as a goal the encouragement of creative thought through the methods they employ (Borodina et al., 2019).

Creative thinking is prevalent in many disciplines, including economics, sociology, and education. However, research into how pre-schoolers' pedagogical techniques influence the growth of pre-school children's creative thinking is just starting (Leggett, 2017). In the local context of Pakistan, there is a dire need to conduct studies on the creative thinking of pre-schoolers. As per researchers, no study has been conducted on pre-schoolers to develop their creative thinking using science activities. They are based on the activity-based teaching method. The researchers designed the current experimental study to investigate the effect of science activities on their creative thinking.

REVIEW OF LITERATURE

Various studies have looked into the practicability of teaching skills and methods learned in teaching strategies to other contexts, all intending to enhance students' education. This allowed researchers to assess whether or not the desired learning goals had been attained and to what extent, relative to other instructional methodologies, through the transfer of abilities learned in the creative thinking of the pre-schoolers.

Bahar and Aksut (2020) conducted a study to determine whether problem-solving abilities in pre-schoolers aged 5 to 6 could be developed through the use of activity-based science teaching techniques. In all, 32 students were a part of this investigation. A control group with a pre-test-post-test design was used. The experimental group underwent a 12-week implementation of activity-based scientific teaching techniques developed by the researchers. The outcomes demonstrated that problem-solving abilities in pre-schoolers might be improved through activity-based science education techniques. Pre-school educators should keep a few things in mind to foster their students' creative thinking (Lucchiari et al., 2019). Teachers of young children should foster creativity by providing various stimulating resources that allow children to use their imaginations, dream big, share their thoughts and feelings, feel valued as unique individuals, and be exposed to new points of view (Al-Hashimi et al., 2019). Students should be encouraged to use their imaginations through imaginative

play and a genuine interest in and appreciation of their new toys. In addition, teachers need to encourage youngsters and praise them for their creative efforts (Singh et al., 2020).

Alfonso-Benlliure et al. (2013) investigated the effectiveness of a pre-school creativity intervention program. The creative intervention program was used with 44 kindergarten-aged children aged 60 to 71 months. The study revealed that the creativity intervention program improved the quality of creative thinking in children's work. Cheung (2010) looked into how creative affect activity in pre-school helped foster creativity and innovation. She visited three separate pre-schools, each with 12 students and three teachers. She engaged in creative movement exercises that adhered to four tenets: present the theme; develop and explore physical abilities; create/express/appreciate; and perform/appreciate. The results of her study suggest that engaging in creative activities is an effective way to foster and develop children's creative thinking.

Garaigordobil and Berrueco (2011) investigated how a play activity program for pre-schoolers affected the kids' inventiveness. The study's findings led researchers to conclude that the play program successfully fostered children's imaginative behaviour. It may be said that activities like play, theatre, and early learning activities are also effective in enhancing pre-schoolers' creativity in addition to the execution of creativity education programs. Additionally, it can be argued that the students' creativity is positively impacted by the rich, dynamic environment that is established in the classroom and encourages creativity.

Rizi et al. (2011) conducted a study with 60 pre-schoolers going on to kindergarten to examine how participating in group activities affected the creative abilities of 6-year-olds. There was 60 students total, and 30 of them were randomly assigned to the experiment group and the other 30 to the control group. After completing the treatment, the experimental group engaged in group activities as part of their training, and both sections took the post-test. The findings revealed that pre-schooler' scores on inventiveness improved after participation in creative play activities. It was shown that children gain the most from learning to work together on activities. Dere (2019) also established a study to examine pre-schoolers' creativity levels. He employed a conventional statistical design with a pre-and post-test on a single group. During the school year 2014–2015, 184 students (96 males and 88 girls) were enrolled in pre-schools. The pre-and post-tests were the Figural Creativity Forms A and B of the Torrance Tests of Creative Thinking. The findings indicated that pre-school curricula positively increased students' creative thinking.

Yıldız (2000) conducted a study with a sample size of 24 pre-schoolers to assess the impact of an educational curriculum that supported creative thinking on the children's emotional and intellectual development. She gave a curriculum emphasising creativity to a group of 12 kids between the ages of 4.5 and 4.5 for her study. Specifically, she discovered that children who participated in the creativeness education program outperformed those who did not participate in the program on social and cognitive development measures. Dziedziewicz et al. (2013) conducted a study with 128 students who were going on to kindergarten to look at how creative thinking changes from ages 4 to 6. The students were split up into an experimental group and a control group. For five weeks, they used a doddle-book approach that encouraged creativity with 67 students in the control group. The study results showed that the doodle-book program helped youngsters ages 4-6 expand their creativity and imagination.

The focus of the study

Creative thinking of the pre-schoolers has been a challenge for the practitioners. The present study aimed to work on pre-schoolers creative thinking. The objective of the current study is to explore the effect of science activities on creative thinking. To test the data, the researcher formulated the null hypothesis.

- There is no significant effect of science activities on pre-schoolers creative thinking.

RESEARCH METHODS

Research Design

The researchers used the quantitative research method in the present experimental study. To explore the effect of the science activities on the pre-schoolers' creative thinking, the researchers used one group pre-test and post-test design. Behavioral researchers frequently use one-group pretest-posttest design to analyse the impact of an intervention or treatment on a study's sample. There are two distinguishing elements of this research design. One distinguishing characteristic is using a homogenous sample of subjects (one-group design). All respondents are members of the same group and receive the same

interventions and assessments. Second, a linear hierarchy necessitates comparing one dependent variable to another before and after a treatment is applied (a pre-test–post-test design). The effectiveness of a treatment is measured in a pretest-posttest assessment by comparing results from the first assessment with those obtained immediately after the completion of the intervention (Park & Cho, 2020). The researchers took data using a pre-test and then deployed treatment to the sample, and after completing the intervention, the researchers again took the using the post-test.

Participants

Study participants were the pre-schoolers enrolled in a school in the academic year of 2022-23. They were enrolled in the Nursery class, and the researcher used an intact group sampling technique to select them as the study sample. Before starting the experiment, the researcher took informed consent from the school principal, and she was assured that no physical discomfort would happen during the experiment. A briefing related to the study objectives and research experiment was given to the school principal and concerned class teacher. The sample of the current experimental study was 24 pre-schoolers of a school in the city of Lahore.

Research Instrument

The measure pre-schoolers' creative thinking, the researchers adopted the Torrance Creative Thinking Test (TCTT). The current study used its forms, A, and B, to collect data on students' creative thinking. Torrance initially developed it in 1960 (Ergen & Akyol, 2012). There are four different types of TCTT: the verbal form A, oral form B, figural form A, and figural form B. E. Paul Torrance created tests that measure the effectiveness of creative thinking. The figural form in the measuring tool from 196 includes three tasks: starting a drawing, finishing a sketch, and creating another picture that deviates from parallel lines. Fluency, Originality, Elaboration, Abstractness of Titles, Resistance to Premature Closure, Overall Figure, Overall Creativity Strength Rating, and Overall Figural Creativity comprise the figural forms. The verbal form has seven subtests: questioning, presuming, guessing causes, guessing effects, product enhancement, uncommon uses, odd inquiries, and speculating. Figural Form A and B and Verbal Form A and B are related. It is a measurement technique extensively utilised in creativity research since 1966. The researchers carried out validity-reliability and language equivalency analyses on the test's figural and verbal forms A and B for our society's pre-schoolers, elementary school, secondary schools, and adults.

Data Collection

The current experimental study used TCTT to collect data for the pre-test in the first week of August 2022 before providing the intervention. Then the students were taught science activities based on the activity-based teaching method for 16 weeks. Then TCTT was again used for the data collection for the post-test in December 2022.

Data Analysis

After collecting data, it was analysed using the Statistical Package for Social Sciences (SPSS) to evaluate the data gathered from the study participants. The first step in determining the data's normality was to test parametric statistics' assumptions. It was found that the data followed a normal distribution after a Shapiro-Wilk test was performed on the results of the normality tests. So, the researchers utilised a parametric test (paired sample t-test) to examine the difference in the creative thinking of the pre-schoolers at the alpha level of 0.05.

Research Ethics

The current study involved the pre-schoolers of a school present in the city of Lahore (Pakistan). The researchers took informed consent from the school principal and parents of the children enrolled in the academic year 2022-23. The researcher developed school activities considering the age and mental level of the pre-schoolers. All the stakeholders were assured that the data acquired from the experiment would be used for the current study. They were also assured that their school name and students' demographic information would not be shared with anyone at any cost. After conducting the pre-test and post-test, the researcher stored the data on Google drive with password protection.

RESULTS

The purpose of the study was to evaluate the children's creative thinking while they continued their schooling at the pre-school institution. The study's outcomes from 24 students were incorporated into this paper section. Whether pre-school education affects children's creativity in aspects of fluency, originality, elaboration, the abstractness of labels, resistance to closing, overall figure, overall creative

strength scores, and overall figural creative thinking was one for which answers were sought. Table 1 contains the findings of the Paired Samples t-test for comparing the pre-schoolers' pre-test and post-test averages on the TCTT figural Creativity A and B Forms.

Table No. 1 Comparison of Results of the Pre-test and Post-test (N= 24)

Sr N	TCTT with A and B Factors	Test	*M*	*SD*	*DF*	*t*	*p*
1	Fluency	Pre-test	.95	.39	22	2.73	.000
		Post-test	1.31	2.37	22		
2	Originality	Pre-test	1.50	.58	22	-3.98	.000
		Post-test	2.35	1.35	22		
3	Elaboration	Pre-test	2.34	.74	22	-2.58	.000
		Post-test	2.85	1.82	22		
4	Abstractness of labels	Pre-test	3.45	.93	22	-1.93	.000
		Post-test	3.55	1.15	22		
5	Premature closure	Pre-test	2.20	.73	22	-1.81	.000
		Post-test	2.91	.90	22		
6	Overall figure	Pre-test	2.64	.84	22	-1.95	.000
		Post-test	3.50	.90	22		
7	Overall creative strength	Pre-test	.94	.36	22	-1.17	.000
		Post-test	1.45	.75	22		
8	Overall figure creative thinking	Pre-test	2.23	.84	22	-2.01	.000
		Post-test	4.59	2.02	22		

Table 1 indicates that mean score of students in TCTT fluency in pre-test (M = .95, SD = .39) is smaller than that in post-test (M = 1.31, SD = 2.37) and this difference is significant at $t(22) = 2.73$, $p = .000 < .05$. It also shows the results for TCTT originality in pre-test ($M = 1.50$, $SD = .58$) is smaller than that in post-test ($M = 2.35$, $SD = 1.35$) and this difference is significant at $t(22) = -3.98$, $p = .000 < .05$. It also revealed that results for TCTT elaboration in pre-test ($M = 2.34$, $SD = .74$) is smaller than that in post-test ($M = 2.58$, $SD = 1.82$) and this difference is significant at $t(22) = -2.58$, $p = .000 < .05$. It also provides the results for TCTT abstractness of labels in pre-test ($M = 3.45$, $SD = .93$) is smaller than that in post-test ($M = 3.55$, $SD = 1.15$) and this difference is significant at $t(22) = -1.93$, $p = .000 < .05$. Table 1 also shows the results for TCTT premature closure in pre-test ($M = 2.20$, $SD = .73$) is smaller than that in post-test ($M = 2.91$, $SD = .90$) and this difference is significant at $t(22) = -1.81$, $p = .000 < .05$. It also indicates the results for TCTT overall figure in pre-test ($M = 2.64$, $SD = .84$) is smaller than that in post-test ($M = 3.50$, $SD = .90$) and this difference is significant at $t(22) = -1.95$, $p = .000 < .05$. It also indicates the results for TCTT overall creative strength in pre-test ($M = .94$, $SD = .36$) is smaller than that in post-test ($M = 1.45$, $SD = .75$) and this difference is significant at $t(22) = -1.17$, $p = .000 < .05$. It also shows the results for TCTT overall figure creative thinking in pre-test ($M = 2.23$, $SD = .84$) is smaller than that in post-test ($M = 4.59$, $SD = 2.02$) and this difference is significant at $t(22) = -2.01$, $p = .000 < .05$.

DISCUSSION

According to the results, a pre-school instructor designed five days per week for 16 weeks the science activities that encouraged children's creative thinking. It could be claimed that the pre-school teachers' organized events promote the students' creativity.

The Preschool Program prioritises the development of creative thinking, which is one of its general characteristics. Acquirements and creativity-related metrics are included in the program. It has been noted that for the program to be executed in line with its aim, pre-school educators should be creative and put forth an attempt to enhance students' creativity. They should also promote students' creativity with various resources, approaches, and teaching methodologies. Instructors can be credited with acting creatively when developing and carrying out the curriculum.

In 2012, Ergen and Akyol investigated kindergarten-bound children's creative thinking. The study involved 135 students in autonomous kindergartens who were five years old, 72 girls and 63 boys. Pre-schoolers' creative thinking was assessed using the Torrance Creative Thinking Test-Figural Form A. The study revealed that students who attended full-day kindergarten had much greater creative thinking. The article's findings are consistent with those of this research.

Yaşar and Aral (2010) looked into how pre-school education affected the development of creative thinking abilities. They studied 210 kids, 105 of whom had been going to the school for one year, and 105 of whom had just started going there, for this reason. The results from the collected data using the Test for Creative Thinking-Drawing Production (TCT-DP) showed that the creative thinking results of the preschool-enrolled children were higher than those of the preschool-unenrolled children. The study's findings indicate that pre-school instruction benefits the development of creative thinking abilities. These results reveal a correlation with the ones from this study.

The impact of pre-schools on creative thinking in five- to six-year-old children was studied by Bahar and Aksut (2020). They had 32 kids in their study group. It was investigated that children who got pre-school education had much greater average creative thinking than those who did not. It is evident that pre-school education has a positive effect on a child's creative thinking. These results also support the findings of the current experimental study.

CONCLUSION AND RECOMMENDATIONS

The findings of this study indicate that pre-schoolers should place a high priority on science activities. Given that the scientific activities used in this study successfully enhance children's creative thinking abilities, it is possible to propose that creative thinking education programs that incorporate scientific teaching methods and promote pre-school education can be created. To further enhance children's creative thinking abilities, teachers might design learning environments that encourage students' creative thinking. According to student accomplishments and demonstrations, teachers can create activities to help kids become better problem solvers and even incorporate suitable methods and procedures.

It is crucial to study creative thinking with various working groups. The ability to think critically may be learned with the proper instruction. Because of this, longitudinal studies can be employed to examine how children's creative thinking develops in pre-school. Additionally, children's creative thinking can be enhanced by including a wide variety of science activities in the planned educational and instructional programs. Children aged 5 to 6 can benefit from these exercises by developing their creative thinking. Students who can independently develop creative thinking in daily life can do so in contexts where science is involved. Teachers and other instructors can regularly use the activities in their schools by employing readily available resources in the activities.

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