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Research Article

Painting Maths in Mandala Art: Integrating Mandala Art in Mathematics at Preparatory Stage of School Education

Nirupma Sharma^{1*}, Dr. Roohi Fatima²,

¹Research Scholar, Jamia Milia Islamia University, 9650998175, nirupmasharmamcd@gmail.com

²Professor, Jamia Milia Islamia University, 9910952262, drroohiazam@yahoo.co.in

Corresponding author: Nirupma Sharma

Email- nirupmasharmamcd@gmail.com

ABSTRACT: Performance in Mathematics has always been a matter of great concern globally. Maths being abstract, is not liked by many students. The main reasons behind low interest in the subject are because of the very abstract nature of the subject along with pedagogy-related issues. Missing Connections with daily life, and traditional ways of teaching mathematics despite revolutionary changes in textbooks of Mathematics at the Preparatory Stage of School Education are still the main reasons for poor performance in the subject.

This research paper attempts to integrate the Indian Art form- Mandala Art into Mathematics through the Co-Equal Cognitive Integration Style as identified by Bresler in 1995. Mandala Art is known for its healing nature, reducing anxiety, and improving focus. The art of making a Mandala in itself involves mathematics in it. They are symmetrical circular designs. This research paper explores the classroom teaching-learning process of Mathematics through Mandala Art- Reflection Symmetry, lines of symmetry, radial symmetry, Rotational Symmetry, fractions, patterns, angles, etc. are the topics explored through Mandala Art in class 5 at the Preparatory Stage of School Education.

To gauge the impact of Mandala Art on the learning of mathematical concepts, a group of 33 students of class 5, was taught through Arts integration for over a month, and all the topics that could organically be integrated through mandala art (symmetry, patterns, fractions, angles, etc.) were discussed in detail through mandala art images created by the students. The findings of the intervention show that students not only enjoyed creating mandala art but also enjoyed maths learning through them. Children expressed that they did not realize they were learning maths while making mandalas.

KEYWORDS: Arts Integration in Mathematics, Mandala Art, , Mathematics Achievement, symmetry, patterns.

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INTRODUCTION:

Research in the field of education has recognized harmful associations between anxiety and performance in mathematics, commonly evaluated using achievement test scores or grades. The influence of math anxiety appears to have a more pronounced effect on fluency rather than accuracy. Individuals with lower levels of math anxiety exhibit enhanced efficiency, accomplishing a higher number of mathematical tasks per minute, which encompass operations such as

addition, subtraction, multiplication, division, and linear equations, in comparison to those with heightened math anxiety. (Luttenberger et al., 2018)

A growing challenge for many children is a negative outlook on math (Ashcraft, 2002; Popham, 2008; Rameau & Louime, 2007). This negativity often starts early, even before kindergarten (Arnold et al., 2002). Home and school environments play a role, especially for kids from low socioeconomic backgrounds with

parents having less education and negative math attitudes (Scarpello, 2007).

Art experiences are inherent to all children, providing an active engagement that facilitates a more profound comprehension and construction of knowledge concerning diverse concepts. (*ArtIntegratedLearning-Handbook-Classes I-V.Pdf*, 2023).

Art integration entails teaching core subjects through various arts forms. In "The Brain and Learning" (2008), Eisner emphasizes the role of the arts in providing children with meaningful experiences, contributing to cognitive development through active learning. (Eisner, 2008; Baker, 2013a). The arts create significant connections with educational concepts and promote complex thinking by engaging multiple brain areas. The study conducted by Liora Nvotva highlights a significant positive correlation between online math assessments and artistic creations, suggesting that the inclusion of art can enhance understanding of mathematical concepts (Nutov, 2014).

In instances involving mathematics, students can employ relaxation techniques to reduce their anxiety levels. It is recommended to arrange students into collaborative learning groups, as teaching approaches that emphasize competition and individual work have been linked to math anxiety. Arts Integration is one such technique that is not just reduces anxiety but also the group work involved provides ample opportunities for peer-learning.

Keeping in mind the impact of visual arts integration into curriculum and its positive impact, this study is an attempt to integrate mandala art into teaching of mathematics. Also, Concentration is crucial in education, enhancing skills like reading and math. Student disinterest led to disruptive behavior, prompting a study on Mandala Colouring Therapy's impact on Year 3 pupils' focus. Conducted in five Temerloh schools, involving 100 pupils and 20 teachers, the study used interviews and questionnaires. Results showed improved interest and focus, with teachers noting enhanced task completion and behavioral changes. (Shankar & Amir, 2020)

MANDALA ART:

Mandala art, deeply connected to spiritual and ritual traditions linked with Buddhism and Hinduism, displays universe symbolically. The term "mandala," originating from Sanskrit and meaning "circle," utilizes geometric patterns, symbols, and arranged imagery centered around a focal point to express the entirety of the cosmic concept (*Ganith_Volume-1_Issue-1-1.Pdf*, n.d.). Comprising elements such as circles, squares, spirals, and radial designs, mandala art includes specific colors, representations of deities, animals, and mystical objects, each bearing spiritual significance.

Mandala art is characterized by its evident circular symmetry, wherein patterns emanate from a centre, promoting meditation through a focus on unity and balance. The central area often includes symbolic elements like deities or lotus flowers, conveying spiritual concepts. Repetitive patterns like stars, wheels, and spirals surrounding the central axis underscore the

notions of cyclical change and interconnectedness. The incorporation of shapes such as circles, squares, and triangles within the mandalas represents ideals of perfection, stability, and spiritual ascent, illustrating the harmonious integration of earthly and divine realms. (Mandala Art, n.d.).

Engaging in mandala coloring, a simple yet impactful intervention, has the potential to improve the concentration and cognitive skills of children who may be susceptible to ADHD. Coloring serves as a calming and stress-reducing pastime, aiding children in managing their emotions, concentration, and behavior. Coloring mandalas acts like a form of mindfulness meditation, allowing kids to concentrate on the current moment and reduce distractions. This can positively influence the attention of children displaying symptoms of ADHD. (Singh et al., n.d.)

Saudamini Madra, an artist, talks about finding peace by looking at the balanced and symmetrical designs in art and the world. Mandalas, which we talked about before, connect math (geometry) with art. Engaging in the creation of mandalas brings happiness to Fernanda Bonafini, an artist and math teacher, who notes that the process induces a sense of calmness and relaxation, resulting in a noticeable slowdown of her breathing and heartbeat. According to Bonafini, this shows that mandalas are like a kind of therapy because they bring together the mind and body in a positive way through their balanced and symmetrical designs. (*Ganith_Volume-1_Issue-1-1.Pdf*, n.d.)

ARTS INTEGRATION:

Arts Integration involves a pedagogical approach in which students demonstrate and enhance their comprehension using an artistic medium. They engage in a creative process that connects an art form with another subject, addressing educational objectives in both areas. (*Definingartsintegration.Pdf*, n.d.) Adding arts to lessons and tests make the lessons more interesting. It lets students be creative and explore ideas in different ways. They can use their strengths to show what they've learned in various ways. (Ross, n.d.) According to Eisner in *The Brain and Learning* (2008), the arts give children experiences, meaning, and help in developing their thinking. They create meaningful connections with the concepts taught through active learning. Engagement in the arts additionally fosters the cultivation of critical and intricate thinking skills by activating various regions of the brain. Eisner identifies eight competencies that the arts help develop for cognitive growth, such as understanding relationships and recognizing that problems can have multiple solutions. The arts aren't just a form of expression; they also stimulate cognitive abilities. Vaughn and Winner (2000) discovered that students who enrolled in a greater number of art classes achieved higher scores in math, verbal, and overall SAT scores in comparison to their counterparts who did not participate in art classes. (Vaughn & Winner, 2000)

CO- EQUAL COGNITIVE STYLE OF ARTS INTEGRATION:

Bersley identified four integration styles in education, each with distinct objectives, content, teaching methods, and roles within the school: subservient integration, co-equal integration, affective integration, and social integration. In the subservient style, arts support the core academic curriculum in terms of content, teaching methods, and structure. The co-equal approach regards the arts as an equal collaborator, integrating the curriculum with content, skills, expressions, and modes of thinking specific to the arts. Affective integration, the third style, focuses on emotions and attitudes toward art, emphasizing student-centered learning and creativity not addressed by the academic curriculum. The fourth style highlights the social function of the school and its role as a community. (Bresler, 1995)

OBJECTIVES:

To Investigate the various concepts in Mathematics that can be effectively conveyed through Mandala Art integration in a classroom setting.

Evaluate the effectiveness of Mandala Art as a pedagogical tool for enhancing the understanding of mathematical concepts among students in the fifth grade. To Examine the impact of integrating Mandala Art into the teaching of Mathematics on the learning outcomes and comprehension of Class 5 students.

METHODOLOGY:

SAMPLE: The study was conducted on a group of 34 students of Class 5 of a government school in Delhi.

METHOD:

This study utilized a quasi-experimental design to explore the effects of incorporating Mandala Art into the Mathematics curriculum for fifth-grade students in the Preparatory Stage of School Education. The

experimental group consisted of 35 students, and the intervention spanned a month.

The Co-Equal Cognitive Integration Style, as conceptualized by Bresler in 1995, served as the guiding pedagogical framework.

The curriculum was designed to seamlessly integrate Mandala Art with a range of mathematical concepts, including Reflection Symmetry, lines of symmetry, radial symmetry, Rotational Symmetry, fractions, patterns, and angles. The instructional approach involved creating designs of Mandala Art that inherently embodied mathematical principles. Discussions on these mathematical concepts were facilitated during and after the art creation process, underscoring the interrelation between the artistic medium and the comprehension of mathematical principles.

PROCEDURE:

To gauge the impact of Mandala Art integration, a comprehensive data collection strategy was employed, encompassing both qualitative and quantitative dimensions. Qualitative data entailed the observation of student engagement, expressions, and interviews of students. Quantitative data, on the other hand, comprised the administration of pre- and post-intervention test scores. Quantitative data is analysed through Excel with the help of Data Analysis ToolPak. t- test: Paired Two Sample for Means was calculated to analyse the difference in Pre-test and post test scores of the class 5th students. Post test was conducted after intervention i.e. Mandala Art integration into teaching concepts of mathematics.

Hypothesis:

Null Hypothesis: There is no significant difference between the mean marks of the two tests.

Alternative Hypothesis: There is a significant difference between the mean marks of the two tests

t- test analysis of the two- tests taken up:

	MEAN	VARIANCE	P(T<=t) one-tail	t Critical one-tail	P(T<=t) two-tail	t Critical two-tail	t Stat
PRE-TEST	12.26	20.26	.00185	1.692	.00369	2.035	-3.125
POST-TEST	13.74	17.96					

Pearson Correlation Coefficient: 0.80, indicating a strong positive correlation between the two tests.

Hypothesized Mean Difference: 0, i.e. Assumption: There is no true difference in means between the two tests.

t Statistic: -3.13, This is the calculated t-value based on the scores of the two tests.

Degrees of Freedom: 33

ANALYSIS AND INTERPRETATION:

T statistic vs. critical values:

The absolute value of the t-statistic is 3.13, which exceeds the critical values. Using a significance level of 0.05, the critical value for a two-tailed test is approximately 2.035. Since the t-statistic is more

extreme than the critical value, the null hypothesis is rejected.

P values:

P(T<=t) one-tail: 0.00185, P(T<=t) two-tail: 0.00369

Both p-values are less than 0.05 (assuming a 0.05 significance level), indicating that there is strong evidence to reject the null hypothesis thereby suggesting a statistically significant difference between the two tests.

The analysis of quantitative data obtained from assessments conducted after the integration of Mandala Art indicated a favorable connection between the integration approach and enhanced test results. Students who participated in arts-integrated learning consistently exhibited a robust grasp of mathematical concepts,

effectively translating their creative efforts into measurable academic success.

QUALITATIVE DATA ANALYSIS:

Student Engagement: In the sessions where Mandala Art was integrated, students displayed significant involvement, actively contributing to the development of symmetrical circular designs. The classroom exuded enthusiasm, with students expressing a strong interest in delving into mathematical concepts through the artistic medium. Anecdotal evidence underscores occasions when students eagerly worked together on mandala projects, cultivating a positive and collaborative learning atmosphere.

CLASSROOM OBSERVATION, MATHEMATICS INTEGRATION DURING AND POST MANDALA ART SESSIONS:

Over the duration of the intervention, careful observations illuminated the effortless assimilation of mathematical concepts into the Mandala Art creations by students. As students actively participated in conversations exploring symmetry, patterns, fractions, and angles during the meticulous crafting of their mandalas, it became apparent that the integration strategy played a pivotal role in enabling the thorough internalization of mathematical vocabulary and principles. The seamless flow between the artistic process and discussions on mathematical concepts stands as compelling evidence of the successful convergence and harmonious blending of these two domains.

INTERVIEWS OF THE STUDENTS: During interviews with the involved students, a consistent theme surfaced: the delightful revelation that they were acquiring mathematical knowledge through Mandala Art without consciously recognizing it as a typical classroom lesson. Numerous students conveyed their astonishment at the newfound enjoyment of the learning process, crediting the creative and immersive aspects of Mandala Art integration for sparking their interest in mathematics. Furthermore, students expressed an enhanced confidence in comprehending mathematical concepts, as reflected in their observations about the ease with which they engaged with the integrated topics.

FINDINGS:

- The implementation of Mandala Art in teaching Mathematics at the preparatory stage yielded positive outcomes.
- Mandala Art played a pivotal role in seamlessly incorporating mathematical terminology into students' descriptions of their artistic creations.
- Students expressed heightened enjoyment during the Mandala Art sessions and reported an unaware absorption of mathematical concepts during the creative process.
- Assessment results demonstrated a favorable impact on students' understanding and retention of the integrated mathematical content, indicating enhanced performance.

- The statistical scrutiny, specifically through the t-test, affirmed the efficacy of the Mandala Art intervention by revealing a noteworthy difference in mean scores between the two tests.
- Beyond its role as a pedagogical tool, Mandala Art emerged as a vehicle for fostering a positive and enjoyable learning experience. Moreover, it seems to contribute to mitigating mathematics anxiety (Ramos Salazar, 2019) and enhancing focus among preparatory stage students.

CONCLUSION:

The results, substantiated by a combination of qualitative and quantitative assessments, indicate that incorporating Mandala Art into the Mathematics curriculum has a positive influence on student involvement, understanding, and enjoyment of the learning process. The inclusion of statistical analysis, particularly through the t-test, further validates the effectiveness of the intervention. The outcomes of the intervention demonstrated favorable results concerning the incorporation of Mandala Art into the Mathematics instruction at the preparatory stage. Students conveyed a heightened level of enjoyment while engaged in Mandala Art creation and expressed a lack of awareness of acquiring mathematical concepts during the process. The utilization of Mandala Art effectively facilitated students in integrating mathematical vocabulary while describing their artistic creations.

Furthermore, the test outcomes indicated a positive influence on students' comprehension of the mathematical concepts introduced during the Mandala Art integration sessions. The results reflected an enhanced performance in the tests, suggesting an improved understanding and retention of the integrated mathematical content. These findings underscore the potential of Mandala Art not only as a pedagogical tool for teaching Mathematics but also as a means to cultivate a positive and enjoyable learning experience. Additionally, Mandala Art appears to contribute to the reduction of mathematics anxiety and improvement of focus among students in the preparatory stage of education.

This comprehensive approach has the potential to transform teaching methods, highlighting the significance of incorporating creative and artistic approaches for conveying mathematical concepts. There is a call for additional research to delve into the long-term viability and extensive applicability of Mandala Art integration across various educational contexts.

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