

Integration of Techniques of Art in Teaching of Mathematics: A Paradigm Shift in Methods of Instruction

Abstract

Mathematics and art are two subjects which are inseparable from each other, a lot of researches have been done on the integration of these two subjects world-wide, the combination of art in the teaching and learning of mathematics is still in struggling phase. In the present era where the education system of the whole world is focusing on STEAM, the unite of these two subjects has become of the utmost importance. The students who have been given instructions of mathematics using techniques of arts have shown significant improvement in their test scores achievement, development of cognitive abilities, creativity and critical thinking skills. Few students who were struggling in the subject, started finding it interesting when they were taught mathematics using art.

Keywords: Art Techniques, Mathematics, Pedagogy.

Introduction

Mathematics is always considered to be tough and challenging discipline to students as well as teachers but it is essential for human race to learn at least the basics of mathematics. Knowledge of mathematics opens doors of opportunities to mankind to surge. The abstractness of mathematics has made it a unique discipline but it is perceived to be an integral part of daily life contexts. The use of technology in almost every activity of daily life has changed the structure of our society and culture in prolific ways. The detachment of subject has caused inconvenience and negative attitude towards mathematics and mathematical thinking (MalmiVuori, 2001). The unfocused knowledge gained through art, science and technology has transformed the socio-cultural practices of the civilization and new complexities are being discovered and created that has changed the role and significance of mathematics (Niss, 1994).

Aim of the Study

The investigator in this paper tried to incorporate few researches done on the integration of art and mathematics. Teaching and learning mathematics artistically and art mathematically develop mathematical skills of students as well as skills required to prepare them for future.

Review of Literature

The flexibility of learning environment that is being considered an integral approach to art, science, technology and mathematics can be efficiently initiated in the system of education (Vester, 2007) and this may be established with concurrent new models of researches. The pedagogy with less flexibility in it and institutions that are built on the grounds of dogmatic segmentation are more or less ineffective for providing education these days. The ever-changing demands of education in the present scenario require a system of teaching and learning that involves multi-model flexibility and has an integration of art, science, technology and mathematics. For experience centered mathematics education, researches in the discipline encourage us to expand the tools and materials of pedagogy to complement STEM. We all are aware of STEM now being called STEAM (Arthur Yidi, 2017) but what does STEAM is to do with the classrooms and teachers? The time to rebuild curriculum and pedagogy for mathematics is irresistible but sometimes the resources are not just readily available. Science, Technology, Engineering, Arts & Mathematics' integration with artistic, creative holistic design aspects and make the most of the successful models of collaboration among mathematic and arts (Kabai, et.al., 2012).

Rekha

Research Scholar,
Deptt. of Education and Community
Service,
Punjabi University,
Patiala.

S.K. Bawa

Professor and Head,
Deptt. of Education,
Central University of Punjab,
Bathinda.

Mathematics taught through the lens of art can make a difference in the eyes of the child. Mathematics is one of the core subject of education and the student of mathematics must develop the skill of working with materials to enhance their fine motor skills just as an artist might use a brush (Carlson, 2016) but mathematics and art are considered to be separate discipline and a huge number of questions come to the minds of mathematicians and artists about the integration of these two subjects. How do artists make use of mathematical knowledge in their work? How can mathematical knowledge, visualization and simulation become the subject of aesthetic reception or performance?

An attempt to get answers to these questions was made by (Fenyvesi, et. al., 2014) who led an open network of the experience workshop math art movement for the experience centered education of mathematics in 2008 where mathematicians, artists, craftsmen, toymakers, children, parents, teachers, scholars, engineers, architects participated. They looked for the answers through various types of interactive hands-on, skill based, play oriented and experience centered combination of mathematics and art. The aim of the workshop was to involve teachers, students and parents in a thinking process where art and mathematics can be merged so that they become able to think art mathematically and mathematics artistically.

The members of workshop contributed to develop new approaches to education that can be productively implemented through the organization of math art workshops, festivals, interactive math art exhibitions and conferences for the development of pedagogy of everyday teaching (Bridges, 2012). The creative artistic practice helps the children to understand and acquaint the algebraically formulated regularities of mathematics to their abilities to make abstract mathematics understandable through a multidisciplinary approach with an integration of art. The students participating in the learning process expand their mathematical knowledge and develop their skills through hand on activities which are carried out by them as well as by the peers (Rogers, 1993). The connections between arts and mathematics, the creative and practical application of hands on activities and the teaching of mathematics using interdisciplinary and inter-artistic approaches have a rich modern tradition. However, numerous difficulties occur in Hungarian schools and educational institutions to implement the reformed pedagogies. There is a demand that math teachers as well as families should involve in the research and have intensive interest in issues of science, art, technology, culture and education that goes beyond the narrow boundaries of the subject and the acquisition of certain level of expertise in objectives, technologies, methods and activities to be used.

A number of researches have been conducted observing the relationship between art, integration and mathematics. Although the education system still realizes these two subjects as separate disciplines and it is the need of the hour to answer the

question that what art got to do with mathematics. The more this question comes to the minds of mathematicians, the more difficult it becomes separate these two subjects (Mann, 2014). Sometimes mathematics can be viewed as an art form. The work of mathematics and art can be considered in the concepts of ratio proportion and symmetry. Both the subjects require creativity and willingness to ask questions, explore answers, experiments with new methods of expression and take risks. The enormous works of art can be seen from mathematics point of view and they can be used in illustrating many concepts of mathematics and create interest among the students. Teachers can use art as a pedagogical tool to introduce mathematical concepts. The work of art promotes and intensifies the students' interest immediately. The teacher uses the art to help students to draw out one's own range of questions. Carlson (2016) in her action research study examined that art integration in Montessori mathematics influences the students' feelings towards mathematics. She narrated that art was always her passion and incorporating art into the pedagogy of mathematics is something she inspired to research.

The art inspires creativity and intellectual inquisitiveness (Appel, 2006). Art encourages students' cognitive engagement along with offering them sense of personal ownership. Art makes an impact on cross circular achievements. The nature of art that provides hands-on experience builds bridges between the concrete and abstract mathematics. Teaching arts and mathematics together fosters a whole brain development of students and Arts yield base to organize, communicate and understand information and provide humans with those skills which they need to learn and thrive in the changing global world (Parr, Radford & Snyder 1998; Hartle, Pinciotti & Gorton, 2014). Arts education energizes the school environment and develops higher order thinking skills for life and work and improves student's performance. When Art is unified into the math curriculum, the students develop skills to use for rest of their lives. Teachers, parents, students & administrator talks about the change in the child's level of engagement physically, socially emotionally and cognitively after the instructions given to them using art. The researches have shown that how that teachers who use art in their lessons benefit their students with increased performance. The intensity of art integration can also affect a student's learning. The research showed that students did better when teachers focus on one or two disciplines instead of attempting to integrate art in to all subjects of curriculum (Ingram & Riedel 2003). The boundaries of learning were pushed to what the students were expected to learn.

Arts are more than just expressive because they develop cognitive reasoning too. Integration of art can lead to increased academic achievement. Using art in educational instruction builds a framework for cognitive development by developing skills which can be used throughout the life. This framework focuses cognitive activities and improves students' performance (Baker, 2013). The art programs have

also seen greater achievement by struggling Students. Using art as a medium of instruction develops skills that are transferable to other academic areas (Gullatt 2008). Educators world-wide are challenged to decrease the achievement gap. The teachers who integrate the arts into their curricula find the students are better able to understand and it meets the needs of the students. It provides more effective path for at risk students. The arts are universal and have spanned across culture and time. Humans have a biological need for beauty and harmony. Art engages the brain and the body. Feelings and senses are connected (Hartle, Pinciotti & Gorton, 2015). Art provides many opportunities for the body and brain to develop creatively. Discipline and practice are the pre-requisite for both art and mathematics.

When art is used with other aspects of curriculum, students used their higher order thinking skills. One's ability to use both left and right brain allows both logic and creativity to take place. It enables all learners to imagine, explore, experiment, create, reflect, assess and share their work with others (Robinson 2013). Researches also showed that cultural transformation occur through art integration. The individual who has practiced art integration in his values and beliefs brings meaningful cultural change and students begin to exhibit new ways of learning. Teachers need to be ready for the pedagogical approach of integrating art in to various subjects. The paradigm shift has taken place from seeing the pedagogy, discussing art and applying the approach to the practice of teaching and learning of mathematics (Charland, 2011). The research showed that art integration in mathematics assists students in developing critical skills. It offers the students many opportunity to develop thinking skills along with higher order questioning. In action research carried out with an objective to establish whether arts integration in Montessori mathematics was a contributing factor to student engagement and an increase in standardized test score showed that over time the students became more confident in both their art and math skills. In the beginning of study, students were quiet and unsure of their abilities. As the time went on, significant growth was shown by students for the engagement in the class room lessons. The students were benefitted from working in small groups and from building a sense of community and trust with one another (Carlson 2016). The teachers who use more innovative methods of instruction in class room could inspire students to learn more and insightful mathematics. The students acknowledged that mathematics is always an important subject in schools and in everyday life and has an impact on their future careers but to learn it further they believed that it should be made more interesting, experiential and more applicable to them (Fenyvesi, et. al., 2014).

Conclusion

To consolidate the final thoughts of the present paper, it can be said that the benefits of an integrated curriculum which recognizes that the subjects within the curriculum are connected to each other and have been noted by several educationists,

philosophers, curriculum theorists and many others. Each art integrated lesson for teaching mathematical concepts can become students' friendly lessons. The techniques of arts reach students in ways that they are not otherwise being reached. It connects students to themselves and each other, transform the environment for learning, provide learning opportunities, provides new challenges for those students who already are considered successful, connect learning experiences to the world of real work, enables young people to have direct involvement with the arts and artists, and supports extended engagement in the artistic process. Artistic experience is essential to learning. Integrating the arts into math fosters development of the whole brain, linking and strengthening both the cognitive and affective regions of the mind. Art brings enjoyment to the lives of those who embrace it.

References

1. Appel, M.P., (2006). *Arts Integration Across the Curriculum. Leadership*, 36(2), 14- 17.
2. Baker, D. (2013). *Art Integration and Cognitive Development. Journaling for Learning Through the Arts*, 9(1).
3. C. Rogers, & H. J., Freiberg. (1993). *Freedom to Learn, New York: Merrill*, 1993.
4. Carlson A.E. (2016). *Arts integration in Montessori mathematics. A master's paper. University of Wisconsin, River Fall*.
5. Charland, W., (2001). *Art Integration as School Culture Change: A Cultural Ecosystem Approach to Faculty Development. International Journal of Education and the Arts*, 12(8).
6. Fenyvesi, K., Kokima, R. & Lavicza, Z. (2014). *Experiential education of Mathematics: Art and games for digital natives, Kasvatus&Aika*, 9(1), 107-134.
7. Gullatt, D.E. (2008). *Enhancing Student Learning through Arts Integration: Implications for the Profession. High School Journal*, 91(4), 12-25.
8. Hartle, L.C, Pinciotti, P., & Gorton, R.L. (2015). *ArtsIN: Arts Integration and Infusion Framework. Early Childhood Education Journal*, 43(4), 289-298.
9. Ingram, D., & Riedel, E., (2003). *What Does Art Integration do for Students? Center for Applied Research and Educational Improvement*, 10, 1-42.
10. Kabai, S., Fenyvesi, K., Szabo, I., Stettner, E., Szilassi, L., Lenart, I. & Berczi, S. (2012). *Experience-workshop in mathematics and space education: joyful teaching program in Hungary. 43rd Lunar and Planetary Science Conference, LPI Contribution No. 1659, id.2611, Houston*.
11. Malmivuori, Majra-liisa. (2001). *The dynamics of affect, cognition, and social environment in the regulation of personal learning processes. The case of mathematics. Academic dissertation. Helsinki: University of Helsinki*.
12. Mann, E. L. (2014). "What's Art Got to Do with Math?" *Teaching for High Potential, Winter*, 7.
13. Niss, M. (19945). *Mathematics in Society*, In: R. Biehler, R. W. Scholz, R. Str  sser, B. Winkelmann eds., *Didactics of Mathematics as a Scientific*

Discipline. Dordrecht: Kluwer Academic Publishers, 367-378.

14. Vester, F. (2007). *The Art of Interconnected Thinking*, MCB.
15. Parr, N., Radford, J., & Snyder, S. (1998). *Kaleidoscope: Building an Arts-Infused Elementary Curriculum*. *Early Childhood Educational Journal*, 25(3), 181-188.
16. Robinson, A. H., (2013). *Arts Integration and the Success of Disadvantaged Students: A Research Evaluation*. *Arts Education Policy Review*, 114(4), 191-204.