

**INTEGRATION OF ARTS IN MATHEMATICS TO
DEVELOP POSITIVE ATTITUDE AND
EFFECTIVE CONCEPTUALIZATION**

**A thesis submitted during 2023 to the University of Hyderabad
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**DOCTOR OF PHILOSOPHY
in
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BY

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19SEMD08**



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A. Research paper published in the following publications:

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ABBREVIATIONS

Abbreviation	Full Form	Pg. No
CBSE	Central Board of Secondary Education	38
CGPA	Cumulative Grade Point Average	52
DEAA	Department of Education in Arts and Aesthetics	23
ICSE	Indian Certificate of Secondary Education	84
KG	Kindergarten	65
NCERT	National Council for Teacher Education	22
NCF	National Curriculum Framework	15
NEP	National Education Policy	24
NISHTHA	National Initiative for School Head's and Teacher's Holistic Advancement	171
SD	Standard Deviation	82
SPSS	Statistical Package for Social Sciences	85
SSA	Sarva Shiksha Abhiyan	23
SSC	Secondary School Certificate	38
UNESCO	United Nations Educational Scientific and Cultural Organisation	24

Abstract

Education is vital in achieving particular ends and goals. Learning various subjects in schools by different means is mainly to achieve the pre-determined goals. Mathematics always has a key place in school curriculum because it is considered knowledge indispensable throughout the globe. A segmental teaching is necessary in the present education system which encourages the learners to participate in the process that helps to earn knowledge in acquiring education. Teaching learning process shall have an aesthetic component in it, without which the learning stumbles and lags behind. Present educational system needs innovative and modern strategies for teaching and learning. There is a need to change the strategies of teaching Mathematics education to the students in elementary schools. One of the modern strategies is teaching mathematical concepts through integrating different art forms. The primary aim of integrating arts into the mathematics classroom is to make the learner relate the mathematical concepts with their daily routine, to ensure retention and success of learners not only during school years but also throughout life. Students at school learn the best when teaching-learning strategies are applied based on the interest of the learners. By integrating different art forms in teaching mathematical concepts envisages the learner to experience joyful learning as well as remove fear of the subject. Mixed method approach was adopted in the study which includes Quasi experimental single group pre-test post-test design under quantitative method followed by qualitative method. The objectives are to know the attitude of students towards mathematics, to understand the conceptualization

of students in mathematics, to develop art-integrated learning module for mathematics teachers at an elementary level, to study the difference in the attitude towards mathematics through arts integration, to study the effectiveness of mathematical conceptualization, to find the relationship between mathematical conceptualization and attitude through arts integration and to explore the teachers' perceptions of adopting art-integrated strategies in teaching mathematics at the elementary level. Random sampling technique was adopted for the study with elementary schools in Hyderabad as population from which eight elementary schools were taken as sample. Research tools are Mathematics attitude scale, learning module, Achievement test and Teacher Perception questionnaire. The data analysis revealed that elementary students have low attitude towards mathematics as they have fear of mathematics and lack self-confidence in understanding the concepts. Students lack mathematical conceptualization as they have very less practical knowledge and their connections with the subject. There was difference in the attitudinal scores and mathematical conceptualization scores between the pre-test and post-test. Teachers opined that by integrating different art forms into mathematics classrooms is considered an incredible way to engage all students and ensure connectivity with the mathematics curriculum. Teachers feel that arts integration is time consuming in schools and require more professional upgradation for them to incorporate it into school curriculum. Teachers must look at the curriculum and appreciate the importance of mathematics and arts. It is important to see students as individuals with multiple ways of thinking, knowing, and representing information. This study concludes with the suggestion that pre-service

teachers should be provided with in-depth education on arts integration that presents them with the tools to create a coherent art integrated approach to the mathematics curriculum across age groups in elementary school. In-service teachers should take time to educate themselves on the importance of art education and practice integration across the curriculum, specifically in mathematics, to provide their students with multiple opportunities to express their knowledge and make learning meaningful.

CHAPTER I

INTRODUCTION

1.1 Background of the Study

The scope of Education was extensive in ancient India. Knowledge of arts or skills was considered vital in the education curriculum. Our mythologies include many references about arts in texts like Ramayana, Mahabharata, Puranas, and poetry. One can find an exciting art description in a text of Sage Shukracharya from Nitisaar. According to him, there are an infinite number of arts, but there are mainly sixty-four arts mentioned. Art can be mastered by every person born on this earth. No person is great or poor knowing an art form.

In ancient India, the curriculum for Education was framed by the Guru alone. Based on the intellect of his shishya, education was given to them accordingly. Even though there are 64 artforms according to the Ancient India which were listed based in the cultures and traditions prevailed in the history. Each art form was given its name based on the mastery of skills in each area such as poetry, gambling, setting of bed, knowledge of scripts, dance, drama, singing, ritual, garland making, phonetics, computation, palmistry, gemology, gardening, wrestling, cookery, drama and many more.

Education is vital in achieving particular ends and goals. Learning various subjects in schools by different means is mainly to achieve the pre-determined goals. Mathematics always has a key place in school curriculum because it is considered

knowledge indispensable throughout the globe. Mathematics knowledge cannot be confined to arithmetic and geometry but plays an essential role in every field of education. In accordance with social demands, mathematics education at the secondary school level has undergone significant shifts in its goals and objectives. The aim of mathematics in the classroom is to develop children's reasoning, and the core of any mathematical work is the pursuit of clear presumptions and logical consequences. The ability to handle abstractions, a method of problem-solving, and a link to the real world are all aspects of the thinking a student learns in mathematics. The mathematics curriculum must take into account the required effects of universal education. Every student has a privilege of getting a high-quality mathematics education because it is a required subject. Education in mathematics should be both affordable and enjoyable. The majority of students hate math. The significant majority of the students fear math. Anxiety as well as tension that effects a student's performance in math is known as math phobia or anxiety. Math anxiety has been examined academically since the 1950s. To define the fear of mathematics, Mary Fides Gough coined the term "mathematics phobia." Math phobia is indeed is the fear or tension that hinders with math achievement.

1.1.1 Mathematics in School at Elementary Level

Elementary math instruction should help students get ready for life's obstacles. Numerous circumstances involve mathematics. Students learn how to appreciate mathematics, which is a strategic goal based on the idea that math can be used and enjoyed throughout one's life. As a result, school is the best setting to foster this taste for math. However, instilling a dread of mathematics prevents students from

comprehending the real need. Equating mathematics with various formulae and its mechanical procedure makes the students memorise the formulae without conceptual understanding. The need to understand the application of mathematical techniques is necessary rather than recalling the techniques from memory is a difficult task for the students. Students use mathematics as a foundation for conversation among themselves and as a means of communication when working together. The information must be acquired by integrating mathematics instruction into students' everyday experiences. The only subject area in education that explicitly addresses problem-solving ability as a skill is mathematics. It is a skill that is put to use in daily living; various methods and skills that are learned in school are extremely valuable in all areas of endeavour. Intriguing problems linked to real-world situations can be constructed in mathematics, which also offers the chance to start fresh conversations. Students can also use abstract concepts to see the concept's structure, comprehend its relationships, use reasoning, and challenge the veracity of statements in order to gain a deeper understanding of the concept. In mathematics, the ability to reason logically is a great gift that cultivates students' thinking patterns. As a fundamental concept and learning objective for mathematics, it also conveys to the students. Mathematical abstraction, extension, and structurization are all possible through the use of arithmetic, algebra, geometry, and trigonometry, which make up the foundation of the subject, where every component of the overall curriculum reflects this. Additionally, it improves the student's capacity to comprehend mathematics as a whole rather than just as a single topic.

1.1.2 Importance of Mathematics in Education

Mathematics is an ability to settle the mind, a habit of developing reasoning in the things we do. The subject mathematics contributes more in the improvement of reasoning and logical thinking which are important for the development of the intellectual abilities. Therefore, learning mathematics is regarded as essential and required in every nation. Students are required to learn Mathematics which is considered as a basic education. Since the skill and abilities which we acquire from Mathematics is very much essential in every walk of life. Right from the human existence on the earth, this subject is being a fruitful and faithful companion. Mathematics is the oldest branch of science and it is known as queen of all sciences. The knowledge of the subject evolved from the needs of human. This lead to the growth of knowledge in all the fields. The entire world of existence is surcharged with mathematics and there is no get-away from the knowledge of this subject. Everybody needs the knowledge of Mathematics in one way or the other that is from the common man to a knowledgeable man. This kind of knowledge should be acquired from school stage only as this subject is a compulsory subject for students at the time of their primary and secondary Education without any option. Mathematics provides opportunities for developing mental abilities of the child. It helps in character formation. It disciplines the child. The language of mathematics is universal.

Mathematics helps in training the mind and also disciplining it. Learning mathematics enhances the ability to reason and think critically, providing the finest

mental exercise for enhancing cognitive abilities. Mathematics is based on reasoning. Mathematics develops reasoning, decision-making, thinking ability and other abilities in an individual. The knowledge of mathematics helps in solving many real-life problems. Measuring and counting different sorts of fruits introduces numbers, and sets of cutting paper for decorations introduce symmetry. We can find these concepts and explain complicated ideas neatly and precisely using Mathematics. Any theory of Mathematics must account both for the power of Mathematics, its numerous applications, and its practical value in different walks of human life. Mathematics is a thinking process. It is a sort of language and is helpful in personality development. By learning mathematics, a person develops his various abilities, confidence, logical reasoning, imagination, concentration, and thinking power and achieves different disciplines like punctuality, honesty, sincerity, patience, hardworking etc. It places an indispensable role in shaping our minds and behaviour. The nature of mathematics and the power of mathematicians will change by increasing the possibility of comprehending, arguing, and exploring the subject.

1.2 Conceptual Framework

The definition of Art cannot be bound in limited words. It is the personal feeling of a person and every person is unique. Time to time artists and intellectuals have given their views about Art. According to Bharat Muni art is painting, music instrument playing and dance. The word 'Kala' has been used for the fine arts and shilpa for the arts of utility. The special activity which is used to make an object beautiful is known as Kala. Indian traditional treatise mentions sixty four (64)

Kalas. The Lalit kala (fine arts) includes music, dance, sculpture, painting and architecture. Drama and poetry are also fine arts because all they embody the essence of art 'rasa'. Through the medium of art, man can communicate his ideas, sentiments, emotions, and experiences.

The Greek term "ar," which means to make, or fit, is the source of the english word "art." Three concepts underlie art: Art is the process of skillfully constructing or making something. It is the creation of beauty and enjoyment through a skilled craft. The word "An" Kalas, which means "to inspire or offer pleasure," is taken from the root word "Kal" in Sanskrit. The words "beautiful," "sweet," and "sensitive" as well as "pleasure-giving" are both used to describe Kala. as a talent, a skill, or a unique quality.

Art acts as medium through which one can express his own impressions, expressions, feelings and emotions. Art gives relaxation to the tension of man's mind. So, it is very psychological in its nature.

Art tells us the story of man how he lives, he grew and made progress in architecture, sculpture, painting, enrich the lives of people by giving the aesthetic pleasure, by supplying spiritual and aesthetic needs. Enjoying Art establishes the relationship between literature and Art as they each reflect the aspiration, ideas of mankind. The contemporary period and are most important as they are a part of our world and since the development of the Art depends on that of today. Values are most important than facts and dates.

Earlier In the past, art education was part of a secret curriculum, but the NCF of 2005 placed a strong emphasis on making it a core topic taught in all schools and providing the necessary resources. When teachers work with artists and cultural organisations to integrate the arts into the classroom, this is referred to as arts in education. This creates a visually pleasing environment in the classrooms that fosters students' creativity and moral principles. For this, all teachers should be sensitive and applaud the effort, not just art teachers. This sensibility among the students enables them to respond to beauty in various forms and express themselves freely while being aware of their rich cultural heritage. The development of secondary school students overall depends on the arts in education.

1.2.1 Definitions of Arts by different artists

According to Rabindranath Tagore: “Art is an expression of human experiences.”

According to Mahatma Gandhi: “Art is the thought of the spirit. The outer form of man is alive only when his inner self is living.”

According to Tolstoy: “An emotional action or expression which fills the spectator or listener, with the same emotion, is art.”

Rigved: “All truth, goodness and beauty emanate from the God. Art is eternal and unending. The expression, consciousness of the beauty of God is called Art (Kala).”

Art is expressed as the mental and physical activities both involved in doing work. Due to this all-round development of an individual is possible. It is an abstract concept with the expression of one’s feelings in the form of colours, lines, music or words.

1.2.2. Classification of Art forms

Art forms are broadly classified into two they are Visual arts and Performing arts:

(i) Performing Arts are types of art in which people perform either individually or collectively using their voices, bodies, and faces to communicate their feelings, opinions, and emotions in relation to other things. The success really depends on the students' attendance. The phrase "performing arts" appears for the first time in 1711. Performers are artists who engage in front of an audience, such as actors, dancers, musicians, vocalists, and so forth. Dance, music, drama, mime, folklore, magic and many more come under this form of arts. "Students would have trial and errors along the way in making and appreciating every part of the dance, drama, music, etc., they have created. In terms of dancing consist of being a creator or maker, a viewer or spectator or as a doer or performer". (Davies, 2003)

The researcher has chosen few among the 64 kalas based on the relevancy and it's the basic ideas that can be given to the students depending on their cognitive ability and understanding of the subject. The mathematics curriculum is framed in the era to give knowledge of various concepts as a gist of everything but not getting into the deeper aspects when related to its practicality. The present study deals with three performing art forms: Story telling, Dance and Role Play. The purpose of choosing only these art forms is that every child has at least knowledge about the above mentioned art forms. They will easily understand the connections between mathematical concepts and art forms.

a. Dance

The term 'Dance' is evolved from the French word 'dancier'. In a social, spiritual, or performance context, dance is typically described as elegant human movement. Another definition of dance is "non-verbal communication between people and animals. "Bees move in a particular pattern while collecting honey. Nearly all foragers will dance enthusiastically if the nectar source is of excellent quality. Human dances are classified into three categories: Classical dances, Semi Classical dances and Folk Dances. Movements, symbolic gestures and expression form part of choreography. The learners can gain a physical understanding of abstract mathematical ideas by fusing dance and mathematics. Mathematical problem-solving can be combined with the development of dance styles, which can motivate students. By combining movement, rhythm, coordination, physical activity, and many other elements, mathematical concepts can be taught through dance and implemented in the classroom. The most memorable teaching methods are frequently those that are both enjoyable and surprising (Wistrom 2009). Mathematics is considered as a good combination with dance because of the geometric shape in space, asymmetric and symmetric figures, patterns and counting of phrases, (Cuthchen 2006). Learning mathematics through dance will create a joyful atmosphere which is full of creativity, enthusiasm and inspiration for students as the learners experience the context in reality. The concepts which can be taught through dance are Lines and Angles, Symmetry, Time, and Geometry, here free dance forms and folk-dance forms are taken into consideration.

b. Story-telling

Good stories are beloved by all. Throughout our childhood, our grandparents, parents, relatives, and friends told us stories. We have developed a variety of story-telling techniques in India. Every person's existence depends greatly on the art of storytelling. These develop a child's character and enable them to comprehend, visualize, imagine, create, and express themselves in their own unique manner. By this art form students are given freedom to express their ideologies and imaginations and give a shape to the thought process.

c. Puppetry

A puppet is a toy or figure that acts as a stand-in for a real person, animal, item, or concept. The marionette can be moved in a number of ways and is constructed from a variety of materials. String puppets, glove puppets, pole puppets, and shadow puppets are the different types of puppets based on how they are used during performances.

d. Theatre

It is a fantastic form of drama where one or more performers use their abilities in acting, singing, dancing, talking, and theatre arts like masks, make-up, and costume to transport us into a fictional world. Indian traditional theatre can be found in every region of the country. Theatre helps more to express the student's dance skill, to bring out their creative ability and to provide a platform for invention. Some contents of the lesson cannot be understood by the students though they have explained systematically. Such contents are to be dramatized and students are to

perform according to the dramatic roles. If it is so done, students can understand the contents/ lessons easily. In this Art-cultural Education we should utilize theatre to perform/ present these arts like music, dance, action. Small plays, skits are to be performed by students in delightful way. Rehearsals are to be done by selecting bearers to the roles. We should prepare theatre before the show. Though theatre media teachers can complete their syllabus on time. After completion of the lesson the same lesson can be performed by the students as a play/drama , as a skit, as a song or a conversation.

(ii) Visual Arts encompasses different art forms which are visual in nature and appear in front of our eyes which incorporate both sound and image. They are paintings, prints, photography, crafts, designs, conceptual Art, textile art, ceramics pottery, architecture and many more. The rising trend of elevating art and, to a lesser extent, sculpture. Teachers can help students by having them draw various types of lines, such as vertical, horizontal, spiral, and wavy lines. Students demonstrate their own ingenuity while applying what they have learned in their drawings. Additionally, students need to have a variety of chances to observe their surroundings and have room for imagination and creativity. Craft is an outlet of physical expression which is drawn from one's imagination through existing culture. It can be stated as manifestation of the human creative impulse which typically involves usage of hands to create an art form.

a. Drawing and Painting

Painting is the technique of using a brush to apply paints or other materials to a surface. The painting as an object is the product of the action, which also uses other tools like a palette with a knife, a sponge, or an air brush. In the era known as drawing pictures and decorating with colours, the art forms of paintings, sculpture, drawings, and engraving entered human existence on a global scale.. Drawing graphic pictures is also a part of painting. When these paintings are drawn by mixing proper proportion of colours different variations in colors are formed. For this, students need to have the knowledge of ratios so that they get accurate result.

b. Crafts

The craft in India is diverse, rich in history and heritage. Throughout centuries crafts have been embedded into cultures from different traditions of different states within rural communities. There are many crafts prevailing in our country made out different resources such as mud, metals, paper, leaves, wood and many more. Every craft needs measurements to get the appropriate shape.

c. Gardening

Gardening is a way to instruct in the basic ideas in practice which makes the students to learn as well as preserve the ecology. The students' ability to count and determine how many rows to plant and how many seeds to sow in each area according to the available space can be a straightforward skill that they can use throughout their lives, from childhood to maturity. As students get bigger, mathematic garden activities like measuring the size of a plot or gathering statistics

on the growth of fruits, vegetables, or flowers may turn into necessities. Students can become fully immersed in these ideas while pursuing the growth and development of the plant when math is taught using a garden. As they graph out the plan, they gain knowledge of the locale determining how many plants can be grown in a specific location, how far apart they must be, and quantifying the distance between each plant.

d. Culinary:

Beginning with the fundamental operations of addition, subtraction, multiplication, and division as well as ratios, returns, and percentages, culinary arts in mathematics begins. Accurate measurements and scaling of ingredients are used, and production amounts are calculated. Recipes are adjusted up or down based on demand. Math is used to regulate serving sizes, guarantee production consistency, and estimate food costs. Math proficiency has a positive impact on consistency and accuracy in the cooking. The following culinary arithmetic principles, however, are essential for anyone who works in a kitchen: addition, subtraction, multiplication, division, unit conversion, and ratios for both whole numbers and fractions. Using fractions, you can multiply and divide them as well as divide wholes into fractions. Area, volume, and forms are all examples of geometry.

e. Script Writing

There are numerous ways that writing can be directly related to texts being read in the classroom, such as by creating scripts according to the text (Bedard, 2011). According to research, when students labour to write a script, they gain a deeper

comprehension of the text and the assignment's goals. Students writing scripts must take the picture of a scene, character growth, and literary devices into account in order to faithfully depict the events in the narrative. Writing plays enables students to analyse texts in a way that might otherwise go unnoticed. Students are given the chance to alter a text and use their ideas to produce something original. Through script writing students are given an opportunity to explore and connect mathematical concepts to daily routine happening around them. They imagine many characters and understand how they are related to the concepts around them and practical impact of the knowledge.

1.2.3 Major objectives of Arts in elementary school level

- By integrating art with other academic subjects in the curriculum, art fosters in students a greater dedication to the learning process.
- Painting will be a great way for students to learn because it engages all of their senses.
- They'll be able to communicate at school.
- Encourages pupils to pay closer attention to their immediate surroundings. This promotes self-esteem.
- It stimulates perception.
- It teaches children to think creatively to solve problems.
- It teaches to think openly.
- To share and learn the work of Art.
- To learn about the world around.
- To bring the culture of the presiding community into the classroom.

1.2.4 Need for Arts in Education

Art in Education is a budding new approach to Education. Art in Education integrates different art forms into every school subjects. It also enables to foster mutual understanding and social inclusion among the students. This has a great possibility in developing creative and vibrant learning environments in the educational institutions. This can be practiced when there is a need to change the teaching strategies and lesson plans so that it gives an opportunity in encouraging the innovativeness, imagination, creativity, experimentation and develops curiosity in the learner's minds. This helps in reflecting on the necessities and also in anticipating the educational requirements for the future.

At present in India most of the educational institutions are not equipped with the provision of arts in Education as teachers are only trained in methodological content and they are finding it difficult to correlate it to Art based learning due to lack of execution in teacher training programmes. A separate art teacher is appointed in schools where only arts are taught to the children as a separate subject. This will no way help the learner to understand the practical usage of it in all the curricular subjects. The syllabus has to be designed with the provision to use arts as a medium effectively in the teaching and the learning processes. Visual arts (paintings, prints, crafts, photography, textile art) and performing arts are two wide categories of art (dance, music, drama, Storytelling).

Integrated arts education the emphasis on including art education in the school curriculum has been highlighted in NCF 2005, which is in line with earlier literature on Indian education. However, in order to achieve the objectives of education set

forth in NCF 2005, it is essential to have an educational system where children learn in an environment where they are valued. In many schools, not all students are still taught this. When discipline, dread, and stress are linked with learning instead of satisfaction and enjoyment, learning declines. Students need to feel that every individual irrespective of their communities, languages, homes and cultures are as valuable as resources for experience which ought to be analyzed in school. All of them have the capacity and right to study and have access to knowledge and skills, despite the diversity of their abilities. As schools grow and more pupils from all facets of society enroll, there is a need to raise awareness of the significance of needs. The school's perimeter needs to be more permeable to the neighbourhood. Exam-related stress and the issues with course load demand immediate consideration on all fronts.

Learning occurs through interactions with various environments, including nature, objects, and people, as well as through actions and language. Social interaction, physical activity, reading, speaking, inquiring, listening, and interacting in language are all crucial learning processes. setting where learning takes place. Therefore, the setting in which learning takes place has a direct bearing on cognition. Despite not being personalised, a sizable percentage of education still relies on the uniqueness of each student. To aid students in learning, the teacher is viewed as having illuminating encounters. This type of education is enhanced when institutions accept students from various socioeconomic backgrounds. The teacher's job in a constructivist learning situation is to turn academic goals into real-world applications.

As a result, a teacher is anticipated to be a specific type of individual, as stated in the NCF and cited as follows: One who: Loves children and enjoys spending time with them; knows them in the contexts of social, cultural, and political life; treats all children equally; and is unquestionably accepted by the curriculum. believes that children are not merely passive recipients of information and supports their ability to build knowledge; the organisation of learner-centered, activity-based, participatory learning situations discourages rote learning, transforms learning into a joyful activity, play, projects, dialogue, discussions, observations, and visits combine academic learning with useful labour. Children must acquire knowledge and skills in this field and not view it as merely amusing.

1.2.5 Importance of Arts among students

The significance of art in education has been emphasized by those who have studied teaching and learning processes throughout history, starting with the Vedas. Arts like music, dance, drawing, crafts, drama, and other art forms are crucial for helping students create a positive outlook. They are

Creativity: The arts help students express themselves more fully. If students regularly engage in creative thought, it will come easily to them both now and in their future careers. A concept such as geometrical shapes and their properties are taught using painting, metal art, bamboo craft, composing a rhyme and drama makes them to think creatively and goes a long way in moulding of their outlook and attitude.

Improve Academic Performance: the arts not only develop the creativity of the learner but also this creativity spills out in their academic achievements. This will encourage them to participate in the educational fairs and development confidence.

Motor Skills: When there is a movement in the physical work they do will automatically develop motor skills which will directly give them the satisfaction of the work done and yield better results.

Confidence: Mastering the subject directly builds confidence as they get exposed to the stage performing activities and get to reflect on their own progress.

Visual learning particularly for students who are learning to draw, paint, and sculpt in art classes help them build visual-spatial skills. Children should be exposed to more than just their textbooks in order to become well-rounded individuals. Students benefit from art education when learning how to analyse, use, and understand visual information so they can make decisions.

Making decisions and fixing problems: The arts foster critical thinking and problem-solving abilities. They concentrate on developing their artistic expression of emotion. Making decisions and choosing options will undoubtedly continue over into their academic training and throughout their lives, and this is undoubtedly a valuable skill in adulthood.

Perseverance: Arts can be difficult, but by overcoming difficulties and working diligently, students develop a persistence that pays off. As they mature, this mindset will undoubtedly matter, particularly in their careers where they will take on new tasks and experience difficulty.

Focus: Concentration becomes crucial when students begin to persist. Focus is undoubtedly important for studying, learning in class, and working in the future.

Collaboration: It is essential to many artistic endeavours, including ground dancing, theatre, and chorus. To accomplish their shared objective, they must split duties and make concessions. The students learn that even when they don't hold the leadership positions, their contributions to the peer group are crucial to its survival.

Accountability: Students come to understand that their contributions to the group is a responsibility for them. It is crucial that they accept accountability for their actions if they make a mistake. Making mistakes is inevitable, and teaching students to embrace them as part of life will help them later on.

Therefore, the arts teach students to learn for the experience of learning rather than just for the grade, and they help students develop life skills in addition to skills in a particular artistic field. Students who participate in the arts learn to take risks, control risk, and deal with failure.

The Indian system of education needs to be fulfilled with the incorporation of innovative teaching strategies which are relevant based on the professional development of teachers and availability of resources. Through the proposed study art is used as medium to teach difficult mathematical concepts in the elementary school. The present research focuses on improving the conceptual understanding of the students towards mathematics and bring a change in the attitude of the students to make the learning meaningful and joyful. This can be done by identifying different art forms and linking their relevance in teaching mathematical concepts

among elementary students. The inclusion of the arts in the classroom has given students new perspectives on reality, expanded their understanding of their surroundings, and frequently had unnoticed instant advantages for their conceptual growth (Berlinger, 2011). As a teaching method, arts integration links the arts across the curriculum. Students' achievement can be raised by using the arts as a tool to engage and inspire them. The kinesthetic or hands-on aspect of arts education may be a significant motivator to get students interested in subjects other than the arts (Rabkin and Redmond, 2006). In the current research, performing and visual arts were combined to teach mathematical concepts to elementary school pupils. Both the attitude and conceptualization of the students have changed. To put them into practice in the classrooms, the opinion of the teachers is also studied.

1.2.6 Mathematical thinking ability

Mathematical thinking is very important in school education as it is way of learning the basic concepts required in life. Solving problems is one of the most fundamental and ultimate goals understanding and learning mathematics. Teachers need a variety of skills and abilities, such as strong mathematical knowledge, strong reasoning skills, and knowledge of heuristic techniques, in order to accomplish this objective. For students and instructors to develop mathematical thinking abilities, it is important that they have the right beliefs, attitudes, and communication skills.

1.2.7 Mathematical Conceptual Understanding

Mathematics everyday represents the mathematical ideas in a numerous way. Abstract ideas can also be approached using verbal representation, concrete

representation and pictorial representation for better conceptual understanding. If students are exposed to abstract ideas in the beginning, they will have a strong foundation for comprehending concepts and may also turn to memorization, which may not be the best method for deeper learning. With the help of concrete objects and examples from the actual world, mathematics aims to improve students' conceptual understanding, visual representations and discussions of methods and ideas. Connecting more than one idea to their previous mathematical knowledge and its applications are to be within and outside the discipline and interconnecting things.

1.2.8. Students' Attitude towards Mathematics

Attitude is a familiar word used to express an individual's way of thinking, feeling or behaving. Many psychologists have widely used the term 'attitude' in various conditions. According to Alport (1929), "attitude is a mental or neutral state of readiness, organised through experiences, that exerts a directive or dynamic influence on the individual's reaction to all the objects and situations with which it is linked". Beliefs regarding people, objects, and events are referred to as attitudes. Attitude is a learned and developed trait, not an innate one. Attitude can be defined as a learned evaluative response involving affective, cognitive and behavioral tendencies towards specific objects, persons or issues, which is relatively enduring and influencing behaviour in a known way. Simply it is a preconceived notion about people or objects that influence an individual response in a known way. It is generally agreed that attitude is more susceptible to change. Sometimes we can say that attitude brings us rewards or helps in avoiding punishments. Knowledge

represents to the cognitive component of attitude. Attitude may give meaning and coherence to what we perceive. Perceiving or dimpling adding information it consists of relating the information to prior knowledge i.e already existing knowledge which we call cognitive schemes. Attitude may serve as schemes that influence how we perceive and remember information. To have a positive attitude or to be interested in any topic, all these qualities should be developed. Therefore, a person's attitude has a big impact on whether they like or dislike a topic in their studies, and this will vary from person to person.

1.3 Different policies emphasized in the implementation of arts in Education

Policies	Emphasis on Arts in Education
The Indian Education Commission Report (Kothari Commission) 1964-66	The commission recommended that the experts' committee designate a survey that ignores art and job education in schools. Based on this, NCERT suggested in 1966 that art education be examined simultaneously in university education and in all schools.
The National Policy of Education (1986) and Program of Action (1992)	It is advised to engage in community events, expose oneself to different cultures, and work to inspire the younger generations to do the same.
NCERT brought NCF in 1975,1988, 2000 and 2005	It presented a compelling argument for including art education as a crucial component of curriculum development due to its enormous potential to support the healthy development of a child's identity. The Government of India has developed and passed the following fundamental Legislation as a result of all

	these important documents: Children's Rights to Free and Forced Education (Act 2009)
Sarva Shiksha Abhiyan (SSA), 2001	SSA has worked towards comprehensive development and a quality-based strategy. Decentralization efforts have been made with the goal of beginning at the district level for curriculum development. The teaching and learning process will be fully integrated with experiential learning, job experience, observation, sports, the arts, and value education. With community involvement, districts' broad curriculum frameworks will be allowed to specify local content areas.
National Curriculum Framework 2005	The following suggestions are offered for promoting and implementing art education in schools: The educational establishment must actively encourage study in the arts and accord it considerable importance in the curriculum. In arts education, learning has taken precedence over instruction, and instructors adopt a collaborative and interactive style rather than being didactic. Every school should make traditional painting and craft instruction mandatory until class 10, with a focus on this subject. In 2005, Facilities for the NCERT established the Department of Education in Art and Aesthetics (DEAA). Through various initiatives like development, training, study, orientation, and the unfurling of the aesthetic potentialities, it is a separate unit

	that works to advance various art forms in schools by integrating them into the country's educational system.
UNESCO- Roadmap for arts education (2006-2010)	It outlines the importance of art education and its essential role in improving the quality of Education. Therefore, quality education cannot be accomplished without quality art education.
National Education Policy 2020	NEP 2020 para. 4.7 mentions it. A cross-curricular pedagogical strategy known as "arts integration" uses various facets and expressions of art and culture as the cornerstone for the understanding of concepts in a variety of disciplines. In order to foster a positive learning environment and instill the Indian spirit, art-integrated education will be incorporated into classroom activities as part of the focus on experiential learning. This will be done at all levels of the teaching and learning process. The connections between education and culture will be strengthened by this art-integrated strategy.

The creation of the "right of children to free and compulsory education Act 2009"—a important law developed and implemented by the government—was the result of all these documents. The Act has refocused attention on our primary goal and laid the groundwork for all students aged 6 to 14 to receive free, mandatory, high-quality education.

Therefore, providing art instruction in all of our schools is a top priority. The new Act would place a strong emphasis on providing all in-service teachers with sufficient and pertinent training. An intensive programme targeted at a futuristic course will provide quality pre-service teacher education to millions of teachers and student teachers in arts education in order to meet the newly

formed demand for art teachers. introduction of required art instruction component has started to be taught in all pre-service teacher education programmes across India. It's being considered for regularization. With the right channels, committed leaders, an applicable curriculum, and a keen awareness of the proper method to bring about a practical and realistic change, we see ourselves shortly realising our dream.

1.4 Theoretical Framework of the study

1.4.1 Philosophical ideologies

Gandhiji's one of the main aims in Basic Education is Art and Craft Centered Education so that we can encourage swadeshi manufacturing and usage of it. This can be done when children are trained in their capabilities with the help of school and community to make the children skilled and independent. This directly leads to the development of the personality of child and create a balance between the theory and the monotonous learning. Learning through creative stimulation and self-expression is to be imparted. The main idea is to introduce handicrafts in the school curriculum to concentrate on more craft centered Education in the teaching programme which leads to the holistic development of the child with coordination of head, hand and heart in whatever work they do.

Rabindranath Tagore: In order to help children grow and express aesthetic awareness, creative expression, and joy, Tagore concentrated on the arts in education. These activities lay the groundwork for a mature and well-rounded personality. These aspects are being carried out in the Shantiniketan were every

concept is taught through drama, music, craft and dance. This directly develops the learner's interest on the art form as well as on their well-being.

Elliot Eisner was a notable innovator in the education of the arts. He claimed that the importance of the arts in education is crucial for helping children acquire skills. Children learn how to evaluate qualitative connections appropriately through the arts. Children are taught that there are multiple solutions to every issue. Students are taught through the arts that even minor differences in understanding can have significant impacts. Children learn to express themselves through the arts by being motivated. It aids in the improvement of students' critical thinking, ingenuity, and problem-solving abilities.

Ananda K Coomara Swamy is considered as a leading art historian in the twentieth century, who dealt with visual Art, aesthetics, folklore, literature and many more. He believed that art has always had two goals: to satisfy current requirements, or what he called "the satisfaction of present needs," and to preserve and spread traditional moral and spiritual teachings.

1.4.2 Psychological Ideologies

John Dewey promoted the inclusion of the arts in education. According to him, the arts should be "a fundamental component of the curriculum as it fosters creativity, self-expression, and a respect of other people's expression" (Heilig, Cole & Aguilar, 2010). Dewey argues that kids need to get a genuine education that gives them the chance to be creative so they can grow up socially, mentally, and physically. (Heilig

2010). Students can improve their worldviews through art education by developing a fresh knowledge of their surroundings (Goldblatt, 2006).

Lowenfeld promoted the school for blind children has been the focus of his early teaching work. He developed a passion for using artistic creativity as therapy to explain fundamental concepts. His contributions have made a modest but growing impact on the subject of art education. He comes to the conclusion that through the arts, disabled children can not only be socialized, treated, and rehabilitated, but they can also comprehend concepts (Efland, 1990). He explained how the creative process encourages learners of all intellectual levels to think creatively, express themselves, connect with others, and feel good about themselves.

Lev Vygotsky viewed about Arts Integration helps in creating a safe environment for taking risks: “You don’t have to make your drawing look real, its great as long as you like it”. Arts integration has demonstrated that way of learning can be a pleasurable experience, creative and fun in the teaching process. When art becomes a vehicle for classroom learning then whole body, mind and soul will be immersed physically, emotionally and intellectually in the learning experiences. This stimulates the learning directly in the present and cultivates it into a positive mindset for learning in the future.

Sigmund Freud: According to Sigmund Freud, art can be viewed as a pathway that is essential in bridging the gap between fantasy and actuality. Students were encouraged to use art to visibly represent their ideas and emotions, such as memories, wishes, and conflicts, through the arts integration process. They are taught the functions of an individual and member of a family or community through

their verbalizations and artwork. In educational settings, art therapy is an artistic expression that encourages pupil inquiry and, as a result, helps people adjust to life.

Howard Gardner

Gardner's theory diverges from traditional conceptions. Based on his views of intelligence, it is the ability to solve problems valued in at least one culture. Multiple Intelligence theory provides a rich diversified ways of categorizing and understanding cognitive abilities of human. He has pointed out that giving freedom and space for the children to think creatively and understand the concept the way they want to learn will be done only when each child is taught uniquely based on their interest. This focuses on learning in more than one right way so that choice can be given to children in learning the subjects. He identified intelligences into eight distinct categories, including linguistic, bodily-kinesthetic, spatial, logical-mathematical, musical, intrapersonal, as well as naturalist.

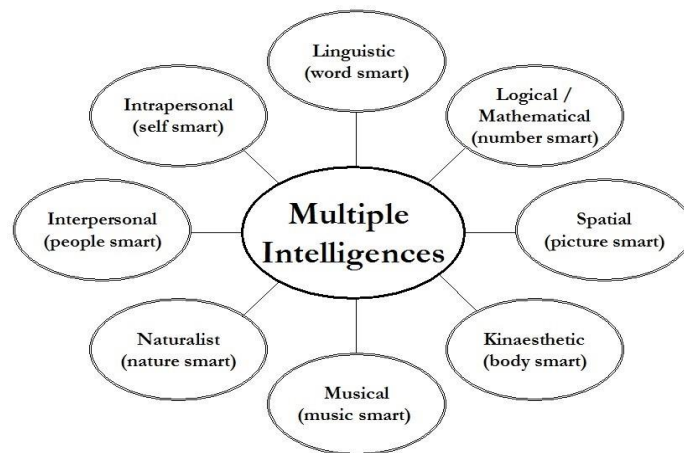


Fig 1.1 Gardner's theory of Multiple Intelligence

Linguistic Intelligence makes use of different words that are effective both in oral and writing. An ability to express one's feelings, emotions, creativity and skill in a language. By integrating art and mathematics the child will make an attempt to understand the language of mathematics through any art form as a medium. This makes them clear in enabling them to know what the concept is about.

Logical-Mathematical Intelligence is helps to detect patterns, give deductive reasoning, logical thinking and effective usage of numbers. It includes the sensitivity relations to logical patterns, propositions, statements, related abstractions and its functions. (Armstrong, 2009). By integrating art with mathematics, the logical reasoning of the child will be developed in understanding the interrelated complex relationships and creative ideologies. Students will be able to classify, generalize, infer, categorize and calculate different processes and directly develop critical thinking skills.

Spatial Intelligence is the ability to correctly sense the visual and spatial environment and perform transformations on various perceptions. It requires comprehension of everything from line, colour, and structure to form. It has been pointed that giving freedom and space for the children to think creatively and understand the concept the way they want to learn will be done only when each child is taught uniquely based on their interest. This focuses on learning in more than one right way so that choice can be given to children in learning the subjects graphically both visual- spatial ideas in order to transfer representations that are concrete in different art forms. Students tries to shift images in their minds by giving a form as physical objects. Therefore, perceptions based on visual are mixed

with prior experiences of the learners' emotions, knowledge, and create a new vision of what is taught. It also enables the creation of mental images that can be used to address issues.

Bodily-Kinesthetics students who are intelligent use their entire body to better comprehend, create, and transform thoughts and ideas. This encompasses athletic aptitudes like coordination, balance, strength, flexibility, dexterity, and speed. (Armstrong, 2000). This helps in interpreting body movements and manipulate the physical objects, establishes coordination between mind and body. Gardner also expresses that characteristic of this intelligence is the ability in a skilled way of using one's body for being expressive and also having a purpose with targeted goals.

Musical Intelligence is an ability to create, comprehend, understand and appreciate music. It promotes a skill to perceive, transform, express and distinguish different musical forms. It enhances sensitivity to the rhythm, melody, pitch and tone quality of any musical instrument. The art of music has the ability represent numbers in the form of octaves, the exponential notions, the intonations and tuning make the musicians to have the innate ability of mathematical learning.

Interpersonal Intelligence is an ability to understand and relate the skill to other individuals. It has both verbal and nonverbal skills of communication, conflict management skills and collaborative skills to motivate others. This allows an individual to perceive and make distinctions with specific moods and their intentions. It helps in motivating the feelings of other people. This includes expressions, gesture, personality and voice among different ideologies.

Intrapersonal intelligence is the capacity to adapt behaviour based on one's understanding of oneself. It accurately portrays a person's strengths and weaknesses. Their knowledge of their own emotions, temperaments, desires, intentions, and motivations, as well as their capacity for self-understanding, self-control, and self-worth.

Experiential theory

David Kolb believed in the potentialities and strength of the people. He believes that human has a natural inclination to learning with a strong desire to grow and progress. Experiential learning is characterized by personal involvement of the learner. It is initiated by self where learner takes initiative with willingness to engage any type of learning. It is characterized by self-evaluation. The learner himself is interested in evaluating the results and outcomes of such learning by applying to the apprehension of learning objectives. It is learner-centered approach which is a key figure in the on-going teaching learning process.

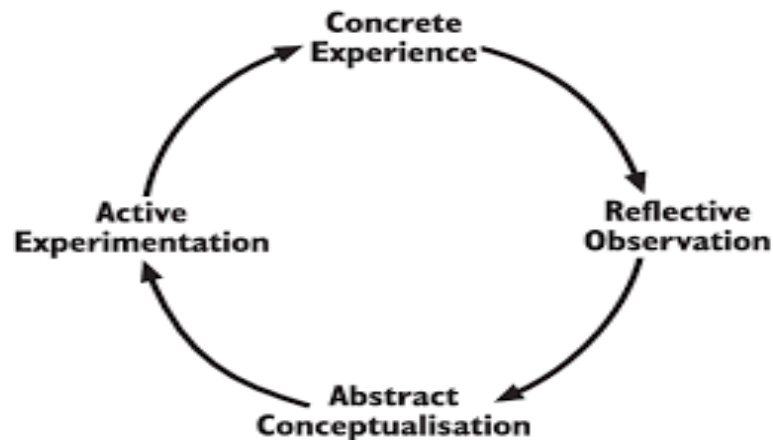


Fig. 1.2 Experiential Learning Cycle

This theory of learning has provided an integrative framework for understanding the teaching process in a better way. It also depicts learning as a four-stage cycle. In the above cycle, a concrete experience is a primary basis for the observation and reflection of the individuals. The observations are then assimilated into theory with the deduction of new implications. These will serve as a guide in creating new experiences. A successful learner possesses the following four skills: active experimentation, abstract conceptualization, reflective observation, and tangible experience. The learner should be able to participate fully in new experiences without bias, to consider and interpret those experiences from various angles, to develop concepts that incorporate those observations into theories, and to use those theories to make decisions and address issues that lead to new experiences. This educational task is challenging because the liberal arts subject matter is depicted symbolically in iconic forms that call for reflective ability and abstract thinking to appreciate its meaning.

Art Integrated Learning Model

The Art Integrated Learning model design is taken from the model suggested by the National Council of Education and Research Training in Guidelines for Art Integrated Learning (NCERT, 2019).

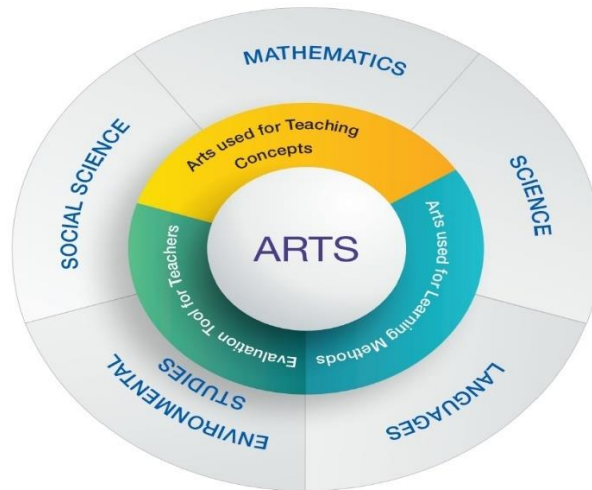


Fig 1.3: Art Integrated Learning Model

Learning "through arts" and "with arts" is the foundation of the teaching-learning paradigm known as "art integrated learning" (NCERT 2019). Arts are taken into account as a teaching method during this procedure. The art-integrated learning approach is primarily used to allow students to explore their creativity by connecting various ideas through a variety of artistic mediums. The performing arts (dance, theatre, music, storytelling) and visual arts (drawing and painting, pottery, clay modelling, crafts, puppet making) contribute to a better grasp of concepts and knowledge building while providing learners with opportunities that are age-appropriate.

1.5 Significance of the Study

Considering the latest National Education Policy 2020, different schools of philosophy have suggested the authorities' recommendations, commissions and values in promoting art education into teaching. It is pertinent that the current

demand is to combine mathematics and art education to make it an engaging topic. Some subjects in the updated mathematics curriculum are more engaging than others. The current educational system, which encourages students to engage in the process of earning knowledge and gaining education, necessitates segmented teaching. Aesthetics must be a part of the teaching-learning process; otherwise, learning stutters and delays. It takes creativity to teach. A lack of artistic sensibility in art is dishonorable. Art integrated focused education aids in the development of a scientific mindset and the ability to conceive objectives and methods for achieving them. Teaching becomes fun when art is incorporated, and a relationship between the instructor and the students is strengthened. Additionally, the teaching-learning process is built on activities. The students' engagement in the subject's significance and depth will improve the groundwork for their subsequent conceptual understanding. Teachers and students will have a greater understanding of how to integrate the arts, observe how math is used every day, and maintain our culture. The researcher has experienced few success stories as a teacher where small activity-based learning using drawing and painting in the simple mathematical concepts has created interest in students to learn more with better understanding. Learning with joy will lessen pupils' anxiety and stress. The visual and performing arts are used as the main learning paths in the arts integration method of teaching and learning. By incorporating a traditional topic and an arts discipline into their curriculum, differs from traditional art education. Teaching non-arts standards through the arts (music, dance, theatre, and creative writing) is known as arts integration (language arts, math, science, and social studies). Art instructors

frequently incorporate other subjects into their art lessons. Students are taught mathematical ideas through the use of colours, shapes, dance, role-playing, storytelling, crafts, puppetry, and many other methods to help them better comprehend mathematics. They can also use images and objects to implement mathematical theory. Mathematics integration is not just about adding and subtracting numbers; it also involves problem-solving, conceptual comprehension, and visualization, all of which will start to take shape in an integrated learning module. Studies have shown that art concepts can be used as a teaching tool to help students comprehend mathematical concepts because they cross over into many different subject areas. However, because many math instructors do not understand what arts integration is or how it functions in the classroom, it is not used as a method of instruction in many classrooms. Studies have found that integrating the arts makes a subject's learning objectives as high as possible. Even though this method has many advantages that can help both teachers and pupils reach their full potential in the classroom. Teachers are hesitant to integrate the arts into their practices due to pressure to complete the curriculum and exam preparation. While one of the biggest advantages of arts integration is undoubtedly improving students' cognitive and academic success. There is a dire need to improve attitude towards mathematics learning among the students through innovative teaching strategies in an effort to help mathematics teachers incorporate art into their lessons with their students learning experiences and activities are being proposed.

1.6 Statement of the problem

This study aims to make the students learn mathematics and joyfully create conceptual understanding. There is a need to remove the notion that mathematics makes students nervous and stressed. The situation in the education system is such a way that even though many initiatives are being taken up by the NCERT, very few schools are following them by just incorporating art education as a project-based formative assessment dealing with very few concepts. The students must develop positive attitude towards mathematics to make their conceptual understanding more substantial and meaningful (Ingram D., & Seashore, K. R., 2003). An attempt is being made to integrate different art forms into the difficult mathematical concepts to make the content more transparent for a better understanding of its application (Catterall, 1999). The present study is stated as ***“Integration of Arts in Mathematics to develop positive attitude and effective conceptualization”*** among the elementary students.

1.7 Objectives:

- To know the attitude of elementary students towards mathematics
- To understand the conceptualization of elementary students in mathematics
- To develop art-integrated learning module for mathematics teachers at elementary level
- To study the difference in the attitude towards mathematics through arts integration among the elementary students

- To study the effectiveness of mathematical conceptualization through arts integration among the elementary students
- To find the relationship between mathematical conceptualization and attitude through arts integration among elementary students.
- To explore the teachers' perceptions of adopting art-integrated strategies in teaching mathematics at the elementary level.

1.8 Hypotheses of the study

- Most of the elementary students have a moderate attitude towards mathematics.
- Most of the elementary students lack conceptualization in mathematics
- There exists no improvement in attitude towards mathematics through arts integration among the elementary students.
- There exists no difference in the mathematical conceptualization through arts integration among the elementary students
- There exists no relationship between mathematical conceptualization and attitude through arts integration among the elementary students

Research Questions

- How to design art integrated learning module for mathematics teachers at elementary level?
- How the teachers perceive adopting art integrated strategies in mathematical concepts at elementary level?

1.9 Operational Definitions

Arts integration: in the present study Arts integration means fusing different artforms into mathematical concepts in the teaching learning process. Drawing and painting, dance, drama, culinary, puppetry, storytelling, script writing, crafts and gardening are the artforms used in the study. Difficult mathematical concepts are taught using different art forms.

Conceptualization means having an in-depth understanding of what is taught and making the student able to deliver it in a quantifiable way. This means students should have practical understanding and application-based knowledge while learning a concept and solving a problem.

Perception in the present study means, teachers' opinion about integrating art forms into mathematical concepts.

Positive attitude means to remove math phobia from the students, bring confidence and interest in mathematics learning, lessen the stress among the students and make learning meaningful.

1.10 Delimitation of the study

- The present study was confined to schools in Hyderabad district only.
- The study is delimited only to those elementary schools which are affiliated to CBSE and SSC in Hyderabad district only.
- The study is confined to mathematics subject only
- Teachers dealing with mathematics subject only participated in the study.

1.11 Overview of the study

Chapter-1: This part discusses the study's background, theoretical and conceptual understanding, significance, objectives, research questions, and hypotheses, as well as operational definitions and delimitations.

Chapter- 2: This chapter summarizes and comprehends previous research related to this study. Critical Analysis and Research gap has been given in this chapter.

Chapter -3: This chapter discusses research method, purpose, research process, tools, data collection and statistical techniques.

Chapter-4: Data Analysis and Interpretation, the categorization, analysis, and interpretation of data are covered in this chapter.

Chapter-5: This chapter includes a research summary, findings, discussion, implication, recommendations and suggestion for future research and a conclusion.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.0 Introduction

"In previous chapter, we have come across the introduction, background, and conceptual framework along with the significance of the study. The present chapter focused on the related literature.

The researcher has acquired enormous experiences gained through their hard work. Many well-known researchers have conducted broad and in-depth studies on the teaching-learning process and mathematics learning problems under different situations at different periods of the world. Specific prominent literature has been referred to as supporting facts for the present study to verify the previous literature.

The literature review of the study deals with the variables like Mathematical conceptualization, the academic achievement, students' attitude towards mathematics and perception of teachers on integrating arts into the mathematics classroom. It will enable the study to clarify the concepts and the definition of key words used in the intended study. It also aimed to inquest research work already done by past researchers in the same area. The past studies will reveal the necessity of the work, which indicates the meaningful and viable relationship among the used variables regarding the subject of mathematics. The review of the research work is divided into four parts according to the study's relevance.

2.1 Studies related to the Arts integration in School Curriculum

Nosek & Goldman (2022) in their qualitative study on art creating innovative processes, was amazed about how art unlocks varied learning pathways. Integrating art can be conducted through art projects in classroom settings. It instils teaching strategy that merges different art experiences with that of the core curriculum subjects to build connections in engaging the learning contexts

Mcclendon (2018) is qualitative research with a narrative inquiry-based method. The basic purpose of this study is for improving the overall quality of education in economically backward schools. Arts integration has proved to increase students' literacy skills and critical thinking. Qualitative data analysis also revealed that only one teacher had pre-service training in arts integration. Teachers who participated in this study had implemented arts integration on a superficial Service Connection level. Support for Professional development to the participating teachers was provided weekly by different teaching artists of the Educational Team. Interactions between student and teacher have been positive and facilitative. The teachers conveyed that it depends on the school's principal on the implementation of the arts integration in schools can be carried in schools.

Criswell (2017) is a qualitative study that has given the necessity to incorporate visual art within the teacher education curriculum. This study sought a remedy to provide a hands-on workshop for educators. It gave art knowledge concerning its strategies for pedagogical interaction in the classrooms for knowledge development. Primary and secondary references, reviews, books and art training materials were used for data analysis. These sources provided a foundation for

training in discussing the benefits of arts integration. The training was evaluated by educators and then implemented in a small group of primary teachers. The training was well received by the teachers and achieved its intended goal. Participants shared enthusiasm for the material provided and reported increased integration into their curriculum.

Lara (2017) study examined the process of art-integration in the elementary art academy in sustaining, developing and implementing the art-integrated curriculum. It also has explored the possibility of cultural wealth as conduit for elementary students. The sample of 10 participants from one elementary school in California has been taken for this study. The research design comprises of semi-structured interviews with one artist, two teachers and one principal. Observations were done on art-integrated lessons and analysis of institutional documents was verified. The result showed that cultural wealth of students was absent in art-integrated lessons, evidence indicated that arts integration was student-centered. It also suggested arts integration empowered students to enrich their learning, inspired them to have respect for their peers, and instilled confidence in them.

Gardner (2016), in his study, has conducted to know methods, strategies and the impact of arts integration on Life skills. Data were gathered through observation, interviews and documents. This study concluded that the school-wide practices of arts integration had promoted students' acquisition of life skills. Recommendations have included education preparation programs with redesigned curricula to emphasize the connections between art and life skills.

Randolph (2016) studied art-integrated programmes that include institution-based models, school reform models based on the arts, teaching artist models, and single art form models in 11 South American countries in order to conduct qualitative research on the relationship between the role of arts integration with individualistic education and relational capacity building in students. This study helps us comprehend how to connect concepts from the curriculum to various artistic mediums. Data have shown that practitioners and professional development providers want to improve relational capacity. Additionally, it changed the emphasis on individual success in school audits. Through more opportunities for self-awareness and collaboration, enhanced communication abilities, and opportunities to demonstrate empathy, art incorporation can also help people become more socially and self-effective.

Liao (2016) it has been found in the study that the participation of the learners in fine art influenced behaviour and attitude. This qualitative study focused on primary students in Art integrated schools. Effectivity of education in fine art made students see, hear and listen based on their physical experiences. The results showed that students' engagement in fine art helped them to think beyond the boundaries of the textbooks or the provable rules.

Goldberg (2016) concentrated on the effects of arts integration on students in Maryland's art integrated schools. Teachers who incorporate art into their lessons have noticed that their students are more driven to learn, are more self-assured, and are becoming more creative. For support, they also concentrated on the teaching process. The findings included that teachers needed a lot of time to create support

structures, collaboration and student test scores for the critical mass of teachers. The use of both the students' bodies and minds to interact with the provided resources and content is a requirement of art-integrated learning. They are actively involved in their education in a variety of ways so that they can comprehend and communicate what they have learned. Students with cognitive disabilities, reluctant learners, and members of economically disadvantaged groups have all been drawn in by the art.

Cornwall (2015) explored art education's role in elementary school by the art educator to facilitate individualized learning experiences in students against the standardized educational culture. The methodology of artography (a traditional sense of drawing, painting and sculpture) was used to investigate a fifth grade. The study was carried out by the subject teacher, art teacher and the researcher. Students used an inquiry-based approach to investigate and experiment with their ideas around an integrated topic in sciences and language art. Students created a work of art as a means to an inquiry. In conclusion, they mentioned a need to empower and enable students to learn in personal and meaningful ways through arts integration.

Marshall (2014), in his study, has mentioned that the aim is to transform the ideas, the information and different ways of doing things through trans-disciplinarity. A qualitative study was carried out in art integrated school curriculum on pre-primary children. Semi- structured interviews were conducted with the teachers. The teachers felt the art-integrated curriculum envisaged the learners to acknowledge more than one intelligence through a trans-disciplinary approach.

Arora (2013) is a qualitative study that has reviewed the importance of Art Integrated learning in 107 classrooms in New Delhi. The research describes the role of arts integration by creating a playful environment that helps the socio-emotional factors of the students. There is a need to implement art education into the school curriculum to make the learners understand the importance of economically productive activities, which may lead to nation progress and building.

Margaret & Daniel (2013) is an exploratory research conducted to investigate how teachers integrate music into the regular mathematical concepts and find the effects of mathematics-music as interdisciplinary lessons in primary school. Mathematical abilities such as strategy, problem-solving and application-based teaching were carried in the classroom. The sample consists of first and third-grade students with respective class teachers. Lessons were designed and implemented by integrating music activities in regular mathematics lessons for five weeks. Results showed that music-math with interdisciplinary lessons positively affected multiple mathematical abilities.

Drake (2012) discussed the processing information naturally involves a number of methods to enhance long-term memory. Students can physically act out a meteorological concept that helps them remember it by creating a dance form to symbolize the relationship between climate change and atmospheric conditions. As part of the generation effect, which directly aids in memory promotion, students can also practice recalling ideas from memory during rehearsals and the performance.

Harloff (2011) is a quantitative investigation into the effects of arts integration on fourth-graders' proficiency in both English and arithmetic. The analysis looked at 4th grade mathematics test results to see if arts integration impacted students' performance in English and mathematics. Utilizing the statistical method ANOVA, the findings showed that integrated art teaching had a positive effect on students' proficiency in math and English language. It was found that music and visual art had a substantial impact on urban fourth-graders' academic performance. To raise students' success, educators and institutions of higher learning must support arts integration.

Benegal (2010) conducted a study in Art and cognitive processes, a qualitative research. According to him, art causes profound changes in the brain, such as strengthening students' attention networks. The pupils' auditory perception, attention, memory, and psycho-motor control were all developed thanks to the use of brain regions associated with music in language processing. The children in this research were in pre-primary school. In their usual classrooms with music and rhymes, observations were made. The findings demonstrated the importance of art education in fostering students' healthy mental growth in the knowledge-based society of today.

Mcclure (2009) focused on determining positive impact on student academic achievement while attending art-based instruction in middle school. Student academic achievement was measured through standardized tests. The study concluded that the art-based curriculum had higher grades overall standardized

scores than the standard curriculum group. The standardized mean scores were higher in the art-based curriculum group than in the standard curriculum group.

Gullat (2007) is survey-based research in a public awareness campaign. It was found that 73% of the people believed that art could help children to develop with high socio-economic status. The respondents believed that children have an opportunity to develop their creativity and sense of individuality. 71% of the students responded that they were satisfied with the present level of art instruction. The survey was conducted through telephonic interviews. The teachers feel that incorporating arts integration into the curriculum is an overburden.

Zembylas (2007) addressed a few of the difficulties teachers encounter when integrating art into the curriculum that are connected to self-efficacy and the organisation of the school's curriculum. Given that science teachers are typically trained to teach particular subjects and are not typically prepared to teach integrated approaches or artistic processes, it was understandable that they felt uncomfortable when integrating art.

Burton et al. (2005) aimed to explore how the advantages of arts integration affected teachers and schools as well as students. Although there are numerous arts integration models being used in schools today, almost all of them are founded on the cooperation of classroom teachers and art experts. As a result of these cooperative partnerships, teachers are more successful, satisfied, and interested in their work, and the school begins to feel like a community of practitioners. These teachers are more ready to take risks in their curriculum planning and in front of their students. They approach their classes more from the perspective of the child

than the adult, are creative in their teaching, open to trying new things, persistent in integrating the art despite obstacles.

Seashore (2003) documented the outcomes of teaching with arts integration and better reading comprehension in students. For disadvantaged students—the group of students teachers must approach to close the achievement gap—the relationship between arts integration and student achievement was, in some instances, stronger. For third-grade students whose teachers incorporated the arts into English/reading lessons, gain scores on the reading exam were higher. The correlation between arts integration and literacy achievement was stronger for English language learners and students who participated in the free and reduced lunch programme. Each statistic is founded on a model that also takes into account how factors like race, ethnicity, and special education may affect students. For third-graders, the correlation between arithmetic proficiency and arts integration was statistically significant.

Ingram & Reidell (2003) has worked on a qualitative study on the use of art and science for academic success at the primary level. The Perpich Center for Art Education collaborated with the Minneapolis Public Schools on a survey titled "Art for Academic Achievement." The goal was to teach students and enhance their learning in subjects other than art, like literacy and science. The comprehensive, sequential art instruction already offered by qualified art educators in the district was not intended to be replaced by arts integration in this. Instead, the project focused on non-art teaching that was strengthened by integrating the arts and belief-based instruction in the arts. In a 2002 preliminary assessment, 21 teaching artists served as informants and took part in focus groups and interviews. This preliminary

analysis showed three things have changed: The artists believed they had developed a stronger sense of purpose, broadened their career networks, and acquired useful assessment skills. According to the involved artists, teachers improved their capacity for collaboration, developed their capacity to incorporate the arts, and modified their practices.

Harvey (1989) studied on the evolution of socio-emotions and art. The study discovered a basic relationship between the creative process and cognition, drive, success, and self-concept. Integrating art into the educational process can be a wonderful tool for emotional education. Social and emotional disputes have been resolved as a result of using art, music, and movement. As a result, creative art exercises the cognitive component of creativity as well as the therapeutic aspect of behavioural change and personality development. This has given rise to the chance to positively influence social, emotional, and academic behaviour by fusing thought and emotion with creative art therapies.

2.2 Studies related to Conceptualization in Mathematics

Senthamarai et al. (2016) studied problem-solving skills in mathematics subjects of 10th-class students in Tamil Nadu. The sample consisted of 80 students from both government and private secondary schools. A survey method has been adopted in the research with a random sampling technique. Problem-solving test was administered in mathematics to collect the data. The results showed that the level of problem-solving skills in mathematics of 10th-class students is average as they memorise the problem rather than understand the conceptual technique.

Caprioara (2015) conducted a study and explained that mathematics is considered the most compelling subject among all the other subjects in developing problem-solving ability. Basic mathematical knowledge leads to solving complex intellectual problems and helps students' cognitive self-regulation. The results revealed that mathematics problem-solving skills could be achieved through contextualizing the concept and re-contextualization. Sustainable and meaningful learning can be achieved by transferring operational and basic mathematical knowledge from teachers to students.

Gupta (2015) conducted a comparative study on problem-solving abilities and academic achievement among students in the Gulbarga district. Results showed that that students' problem-solving ability has a significant influence on the students' achievement.

Bhatt (2014) and Kousar (2010) aimed to study the effect of problem-solving skills on high school students' mathematics achievement. Both studies have found that problem-solving skills are a crucial requirement for success in all mathematics courses starting from the secondary level of education.

Barak (2010) asserted the students about problem-solving strategies helped them accomplish a task, improve their ability to monitor their thinking process and reflect on their learning. Self-efficacy and beliefs about their problem-solving skills and creativity have been enhanced directly.

Kapur (2010) has conducted quasi-experimental research on mainstream secondary school students in Singapore. They have experimented with a traditional

lecture and practice teaching cycle with activity-based learning. The results have revealed that the students have performed significantly better in solving mathematical problems with relatively higher-level concepts than students taught in traditional methods.

Civil (1990) conducted a study on mathematics on problem-solving ability and found that the ability is innate to make meaningful perceptions in problem-solving skills among secondary school students. It has used memory effectively as an essential factor in improving mathematics problem-solving ability.

2.3 Studies on Attitude of students towards Mathematics.

Eugene (2019) This research focused on curriculum issues, such as stress in teaching strategies, that contribute to math anxiety. Overcoming math anxiety requires examining how we teach mathematics in our schools. Our economy, children's potential employment, and their success in higher education are all significantly impacted by this issue. The use of mathematics is crucial to the world economy. Students in elementary and high school may decide to take fewer math classes or math at a lesser level due to a bad attitude towards math. They might decide against going on to higher schooling as a result of this. There are instructional options that can ease students' fear of mathematics. These techniques should be sought out and enthusiastically embraced by present and future educators.

Whyte and Anthony (2019) The study's main emphasis is on New Zealand students' anxiety related to math classes. This research is observational. It is essential to raise the level of mathematical literacy among all pupils. This could be accomplished by hastening the learning of underperforming pupils. This study

primarily concentrated on the potential for math anxiety and ways to help students cope with it.

Chen and Bae (2018) studied how learning and scholastic achievement affect kids. In this research, which included 240 students as a sample, it was discovered that a favourable attitude towards math was the only cognitive-affective factor that accurately predicted academic achievement. According to the functions of the affective-motivational and learning-memory systems, studies on the relationship between a good attitude and academic success were conducted in two separate cohorts of young people. It was discovered that greater engagement in the learning-memory system was linked to a positive mindset. It also showed that the relationship between a positive outlook and better math performance was mediated by more activity and regular use of effective memory-based strategies.

Tanveer & Rizwan (2015)

This research looked into how students' attitudes towards business mathematics were influenced by their gender, math grades, and overall CGPA from previous semesters. The empirical study was conducted using 108 students from the department of management sciences at the Islamia University of Bahawalpur, 18 items measuring attitudes towards business mathematics, demographic data about interviewees, and survey data. Results showed that gender has a small effect on attitude towards mathematics, with men marginally outperforming women. The similarity of this topic is increased by higher accomplishments and grades. Unexpectedly, students with higher CGPAs have a bad propensity for this subject. When compared to the results of other courses, students' performance in

mathematics consistently falls short of average. Universities and business schools need to understand that poor performance and insufficient exposure to mathematics are the causes of failure and a decreased interest in the subject. These institutions should make sure that all of their pupils possess the fundamental mathematical knowledge and skills.

TIMSS (2015)

According to this research, fewer Australian students are majoring in science and mathematics during their senior secondary years. Although many students lost interest in these topics, attitudes like self-concept, usefulness, and intrinsic value were crucial for making subject choice decisions. Latent profile analysis looked at how people's attitudes towards both topics related to one another. 10,051 Australian Grade 8 pupils were used in the data collection, which included six distinct groupings. At the same time, most students were attitudinally receptive to both subjects. Positive attitudes towards both topics were advantageous to both and were linked to greater success in each. Boys tended to be more supportive of both topics than girls, and they benefited more from this relationship.

Mensah et al. (2013) Education researchers and math teachers have long focused their attention on the importance of attitude in the study of mathematics. The literature is replete with empirical proof on the relationship between teachers' attitudes and students' academic success in Mathematics. 100 students and 14 Math instructors served as the study's samples. The students were chosen randomly, and instructors were selected using purposive sampling. The information from the respondents was gathered using two different types of questionnaires. Academic

achievement ratings were calculated using students' end-of-term exam results. A significant correlation between teacher and student attitudes towards mathematics was found by the research. It was believed that teachers' upbeat attitudes inspired pupils to feel confident about learning mathematics. The study's findings were also in line with earlier research on the connection between math students' performance and instructors' attitudes.

Mata (2012) The purpose of this study was to comprehend how certain interconnected factors, such as motivation, background, and societal support, had contributed to the explanation of students' attitudes towards mathematics in the classroom. The findings showed that students had a favourable attitude towards mathematics, and that this attitude was primarily influenced by grades and mathematical success. Despite the fact that the girls' attitudes continued to deteriorate, there was no gender impact. The findings demonstrated that factors linked to motivation are the primary predictors of attitudes towards mathematics, and that teachers and peer social support are also very important in comprehending these attitudes

Rukavina et al. (2012) This quantitative research involved surveying students in grades K through 12 (aged 10 to 14). Workshops in math and science were attended by them. After the workshop was over, we instantly assessed their motivation and interest. In total, 70 workshops were held in Rijeka, Croatian, schools, with 1240 pupils taking part. The workshops were created to promote active engagement in classwork and a more in-depth method of learning that results from meaningful involvement in a real-life issue related to daily living. The findings demonstrated

that pupils enthusiastically embraced this style of instruction. They place a high value on examples, real-world applications, and hands-on experimentation. This form of classroom activity has shown to change students' attitudes towards mathematics and science.

Mohamed (2011) discussed how students' attitudes towards mathematics affected their achievement in the subject as one aspect. The goal was to assess how pupils in a Maldivian school felt about mathematics based on gender differences. A survey asking about students' attitudes towards mathematics was given to 200 secondary pupils in total. The answers to the questions revealed how the students felt mathematics was helpful. The findings demonstrated that there is no gender difference in students' attitudes and that their favourable attitudes towards mathematics are moderate.

Sparrow & Hurst (2010) intended to instill a positive attitude towards mathematics in young children. This research explored the rationale for the idea that mathematics is a pointless endeavour for those without aptitude. In schools, math is taught with no regard for how it will be used or applied. The success of mathematics learning causes children to experience more positive reactions in their learning by utilizing straightforward planning techniques regarding the purpose of any activity.

Olowojaiye (2008) examined how students' attitudes towards senior secondary mathematics were affected by behavioural objective-based and question-based instructional methods. The study's three assumptions were examined at a significance level of 0.05. The study used a quasi-experimental pre-test, post-test,

and control group methodology. Between subjects exposed to behavioural goals and the control group, there was a clear attitude difference. In terms of attitudes, there was no noticeable difference between the research question and behavioural objective groups. Both study groups outperformed the control group, it was discovered. It was an effective teaching method that could foster a favourable mindset towards mathematics. The outcome suggests that changing students' attitudes and habits towards mathematics depends heavily on the classroom instruction strategy used by the instructor.

Akinsola (2007) is a grounded study in which researchers and instructors were given the task of identifying the elements of unfavourable attitudes. The lack of theoretical contributions in attitudes towards mathematics was discussed in this research. Additionally, it covered both favourable and unfavourable views as well as their elements. This research was carried out to ascertain the impact of the simulation-games environment on secondary school students' performance and attitudes towards mathematics. 147 senior secondary school pupils in Nigeria who participated in the data collection. The data gathered for the research was examined using statistical methods, including t-tests and ANOVA. The results showed that the teaching strategy used is to blame for the low academic performance of students in mathematics. Using a simulation-games environment led to better achievement and a positive outlook towards mathematics. The findings demonstrated that the learner's viewpoint and attitude were inferred from their decision of agreement with particular beliefs. Complicated mathematics is viewed as a sign of a bad attitude. A teacher's ability to develop an intervention that enables them to get past some of

the key findings of attitude research now begins with the diagnosis of a poor attitude.

Curtis (2006). The goal of the research was to determine how students' attitudes in math classes affected their understanding of algebra. The main component of lessons is standards-based teaching. In particular, the research looked at how students perceived the classroom setting as it related to learning mathematics. The perceptions of motivation, enjoyment, anxiety, and trust in studying mathematics were recorded. Its applicability in both personal and business contexts was also evaluated. Both the quantitative and qualitative information gathering techniques were used. The research was able to determine whether there was a difference in the attitudes of students towards mathematics. Cooperative learning, problem-solving, discourse, and graphing calculator use were the standards-based pedagogies employed in this research. Student questionnaires, focus groups, observations, and attitude surveys all helped to identify shifts in attitude. According to this research, standards-based pedagogy increased students' mathematical confidence because they felt more competent when solving exam problems. Students also enjoyed the class, showed less anxiety as they became more accustomed to the teaching methods, and realised the importance of mathematics for both professional and domestic use.

Martino and Zan (2001) effective when applied to the teaching of mathematics. A short examination of some theoretical issues covered the students' attitudes towards mathematics and forced them to consider the reasons why they did not select it as a core subject.

2.4 Reviews on Teachers' Perception on Arts integration

Badger (2019) has talked about how primary school teachers view incorporating art into their lessons and how that affects how well their students perform. In a Mississippi elementary school, mixed research methods were used to teach classes that included art. In order to understand the in-service teachers' perspectives, one-on-one conversations, observations, and an online survey were all done. Based on the interviews, observations, and surveys, data analysis was carried out. The study's conclusions emphasized the ways in which teachers can engage their students. The limitations of their perception have prevented teachers from using art, but they have recognized the importance of using art incorporation to enhance students' cognitive, social, and emotional abilities.

Lori et al. (2018) a qualitative and quantitative survey that was conducted in the sixth and seventh grades of Anne Arundel County Public Schools. Two weeks of workshops were held. A quasi-experimental approach was used to gather and evaluate data from the treatment group and comparison schools. According to this research, putting this arts integration strategy into practice correlates with a 77% decrease in discipline referrals and a general improvement in school climate based on teacher, staff, student, and parent perception.

Pines (2018), This research looked at teachers' perceptions of how often and how well art was incorporated into the general education curriculum. 31 special educators and classroom instructors from a university in the northeast of the United States made up the sample. The majority of participants said that the general education programme needs to incorporate art. But many said they felt constrained

by the demands of the programme. The findings indicate that most instructors thought art helped students retain information, comprehend the subject matter, or develop their emotional intelligence.

Lobpries (2016) is an observational study that aims to emphasize partnerships and the advantages of art in education. The idea is to promote collaboration between art and science teachers and to highlight the perspectives of teachers. To ascertain the viability of an art-integrated curriculum in the high school environment, the researcher conducted interviews. Positive effects on teaching and learning have been observed through the analysis and interpretation of art and scientific collaborations, both in schools and in the real world. Teachers, administrators, and curriculum designers who are reinventing or redesigning curricula to suit twenty-first-century thinkers have been inspired by collaborations.

Wright (2016) was a quantitative research that looked at the frequency of arts integration practices in K–8 classrooms as well as their perceived value, who was in charge of implementing them, whether they had enough resources, and whether they had access to professional development in the field. Data was gathered using SurveyMonkey.com, an internet survey platform. In total, 177 individuals took part in the research. When compared to K–8 general education teachers, the results showed that they perceived the need for arts integration, claims for it, its implementation, and perceived comfort level as considerably greater. Additionally, those who had prior high school art experiences were much more comfortable implementing art incorporation than those who had no prior high school or college art experiences. There were no discernible differences in the perceived need for arts

integration, claims of arts integration implementation, and perceived degree of comfort for arts integration implementation between district and school-level managers and K–8 art experts. There were no discernible differences between district and school administrators, general education teachers in grades K–8, and art specialists in grades K–8, in terms of perceived accountability for implementing arts integration, perceived possession of sufficient resources for arts integration, and reported availability of professional development for arts integration.

Liscombe and Gloria (2016) is a case study that focuses on various pedagogical problems, such as teachers' understanding of art-integrated enrollment strategies in schools. The case study examines opinions and reasons for student enrollment through interviews with educators and parents. This study examined Mosaic educators' opinions on art-integrated pedagogy, student profiles, and their own perceptions of the value of the arts through the analysis of their interviews.

Alhaddad (2014) intended to find out how pre-service teachers in Kuwait perceived teacher preparation programmes by describing and assessing their efficacy. The problem of art teacher preparation and current teaching was investigated in this study using a mixed research methodology. A document analysis and survey questionnaire for aspiring art educators who have finished their classroom observations were included in the research. The purpose of this study was to view, investigate, and examine pre-service teachers', beginning teachers', and experienced teachers' perceptions of the efficacy of the teacher education programme in the State of Kuwait, as well as to make recommendations for programme improvement and the creation of regional curricula for the program's

future. This study has generated specific suggestions. Along with longer fieldwork courses and internships, more classroom observations at all teaching levels, more instruction in the art studio, and greater collaboration between the college and the public schools, these recommendations were made. This study made it clear how important it is to properly prepare for lessons and how classmates, managers, and professors of art education can affect learning.

Lemon & Garvis (2013) believed that teaching art in schools is expected because it is an important topic. The Australian National Curriculum differs from teachers' current views in this quantitative study, which was conducted. In order to better understand how pre-service teachers feel about the place of art in primary education, this paper conducted a poll of pre-service teachers. Data was gathered from two Australian colleges. Results were presented based on perceptions of the function of artists in schools, ongoing involvement in the arts in their personal lives, and levels of confidence in their ability to instruct in the visual arts. Teachers, curriculum designers, and decision-makers were given advice on how to support and improve favourable views of art.

George (2013) There were recommendations made for curriculum designers, teacher educators, and policy makers regarding how to promote and improve favourable perceptions of art in primary schools across Australia.

Sweet (2009), He mentions in his research how little art educators are involved in the planning, carrying out, and evaluating of arts integration in K–12 institutions. This research has shed light on how interdisciplinary studio classes can integrate art. According to the research, pre-service art educators who had traditional art

backgrounds mirrored the modernist view that artistic ability is something that is "caught" rather than "taught" in the classroom. In order to contextualise art and art education, a crucial art historical component must be included, and general education methods must be taught.

2.5 Critical Analysis

Integration of Arts with Education means an approach to learning in which students develop an understanding of different concepts or construct new knowledge through different art forms by engaging themselves in a creative process that connects an art form with the concept being taught. Arts, when integrated with different subjects, becomes the medium of the teaching-learning process; thus, different concepts can be easily grasped joyfully. There are developmental and educational advantages for pupils, according to research. Students who attend institutions where art is a core component of the curriculum typically perform better academically than those who do not. Cognitive, social, and emotional growth have a close relationship with arts. Students who participate in art-integrated learning can engage with the subject matter and resources using both their bodies and brains. It directly appeals to each student's particular modes of comprehension and thought expression. In reality, academic success is higher for students who participate in various arts more frequently than for those who do not. (Mcclendon 2018, Criswell 2017, Lara 2017, Randolph 2016).

Strategies for integrating arts create clear links between various content areas. For students, learning experiences are richer when teachers incorporate art learning strategies with non-art material. Information is easier to learn, knowledge transfer

may take place, and information may be easier to remember when students understand the connections between various subject areas. According to some researchers (April 2001; Ingram, 2003; Seashore 2003), integrating arts

into the curriculum has a beneficial effect on students' academic performance. There are studies that support the assertion made by other researchers (Harloff 2011; Curtis, 2008, Richards 2003) that there is a connection between arts integration and student success. On integrating art, there are hardly any experimental investigations.

Based on the reviews the investigator has found that very few studies are done in arts integration using different artforms only up to primary level. Studies have shown that art concepts can be used as a teaching tool to help students comprehend mathematical concepts because they cross over into many different subject areas. However, because many math instructors do not understand what arts integration is or how it functions in the classroom, it is not used as a method of instruction in many classrooms. In western countries, Art subject is taught with other subjects so that children relate the concepts to the real world. In Mathematics students' possess problem solving skills but they lack in the conceptual understanding and its practical usage. Basic concepts such as geometry is taught using arts integration. Reviews show that most of the elementary students have many misconceptions and fear of mathematics subjects. Students have a perception that mathematics is a difficult subject to understand and relate it to real world. Students lack confidence in understanding and attempting the problems during assessment. When mathematics is considered as useful it can be taken into positive consideration in

attitude. Whereas when mathematics is difficult it is considered as negative attitude. Reviews show that most of the teachers confine the integration of arts only in classroom projects. Teachers need professional growth in introducing art in classroom. Most of the reviews focused on introducing visual artforms into mathematics up to primary level only. In Western countries arts integration is carried from early stages with focus on drawing basic shapes in geometry. In our country Arts integration is a budding new approach where students learn the concepts with understanding and acquiring practical knowledge. The present study has included different performing art forms and visual art forms in the mathematics curriculum. Social and Science subjects can be taught using performing arts. But it was very difficult to incorporate performing art forms in mathematics concepts. Studies have found that integrating the arts makes a subject's learning objectives as high as possible. Even though this method has many advantages that can help both teachers and pupils reach their full potential in the classroom. Teachers are hesitant to integrate the arts into their practices due to pressure to complete the curriculum and exam preparation. While one of the biggest advantages of arts integration is undoubtedly enhancing students' cognitive and academic success, there is a dire need to improve attitude towards mathematics learning among the students through innovative teaching strategies. As the NEP 2020 and NCERT is specifying to teach the curriculum through Arts hence there is a need to incorporate in schools especially in mathematics so that the notion of math anxiety and fear will be eliminated completely. The present study has been carried by including most of the different performing and visual art forms in the mathematics curriculum.

2.6 RESEARCH GAP

Review of the related literature has showed that mostly Qualitative studies were conducted in the area of Arts integration from varied Universities in North America, United Kingdom and China. Very few studies are done in our country as NCERT has shifted its focus on Arts integration since 2019. At Present National Education Policy 2020 also focused on Arts integration into the school curriculum. Efforts are made in the implementation process throughout the country. Unlike India, most of the developed countries have Art Integrated Schools with specified Art Integrated curriculum and research has been carried in the Art- Integrated schools only. Most of the researchers have focused from KG to Primary level only. It was very easy to incorporate visual arts in basic concepts in mathematics such as three-dimensional shapes and two-dimensional shapes and were taught through arts integration. Focus was on the holistic development of learner. Most of the studies suggested on developing professional growth in teachers by conducting training programmes and workshops for pre-service and in-service teachers for effective and creative teaching. Very few experimental studies are conducted in this area due to lack of school resources and time constraints by the school administration for conducting research. Perceptions of the teachers was considered without any intervention programme conducted in schools. The primary aim of the researcher is to make the students understand the concepts with its practical applications in every field and develop a positive attitudinal change in them towards mathematics learning. Teachers need to get acquainted with Art-Integrated teaching strategies in classrooms and make the learning meaningful and joyful.

CHAPTER III

METHODOLOGY

3.0 Introduction

The earlier chapters discussed the theoretical framework of the study, objectives, hypothesis, review of literature and research gap.

The present chapter fully describes the plan and procedure adopted in carrying out the present investigation. It will provide a clear line of action concerning research design, hypotheses, method, variables, population, sample and sampling technique, tools, and statistical techniques.

3.1 Research Purpose

The main intent of this investigation is to know the attitudinal level of the elementary students in mathematics in order to develop positive attitude by incorporating art integrated strategies into the mathematical concepts. An experimental study is conducted to study the effect of art integrated learning in mathematics among elementary students. This study also investigates the perception of mathematics teachers in adopting art integrated strategies into the mathematical concepts by making the learning process meaningful.

3.2 Variables

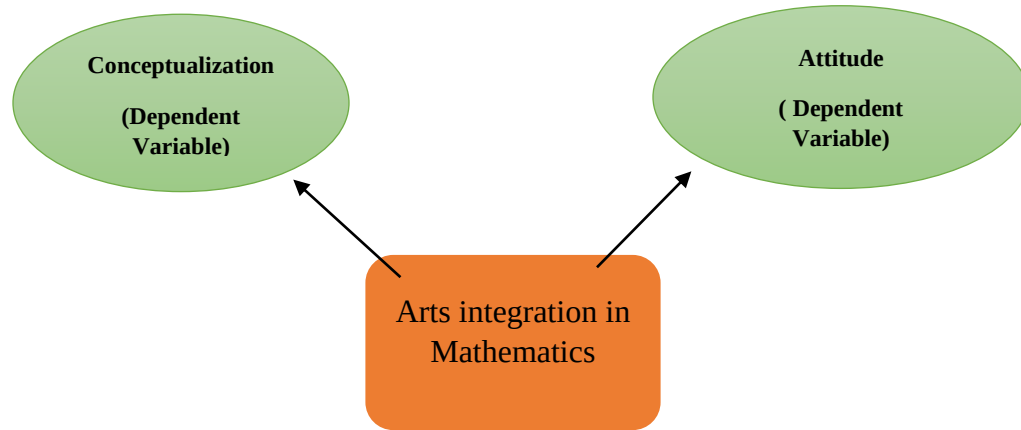


Fig 3.1: Variables of the study

3.3 Hypotheses of the study

- Most of the elementary students have a moderate attitude towards mathematics.
- Most of the elementary students lack conceptualization in mathematics
- There exists no improvement in attitude towards mathematics through arts integration among the elementary students.
- There exists a difference in the effectiveness of mathematical conceptualization through arts integration among the elementary students
- There exists no relationship between mathematical conceptualization and attitude through arts integration among the elementary students

Research Questions

- How to design art integrated learning module for mathematics teachers at elementary level?

- How the teachers perceive adopting art integrated strategies in mathematical concepts at elementary level?

The schematic diagram is an overview of the research process :

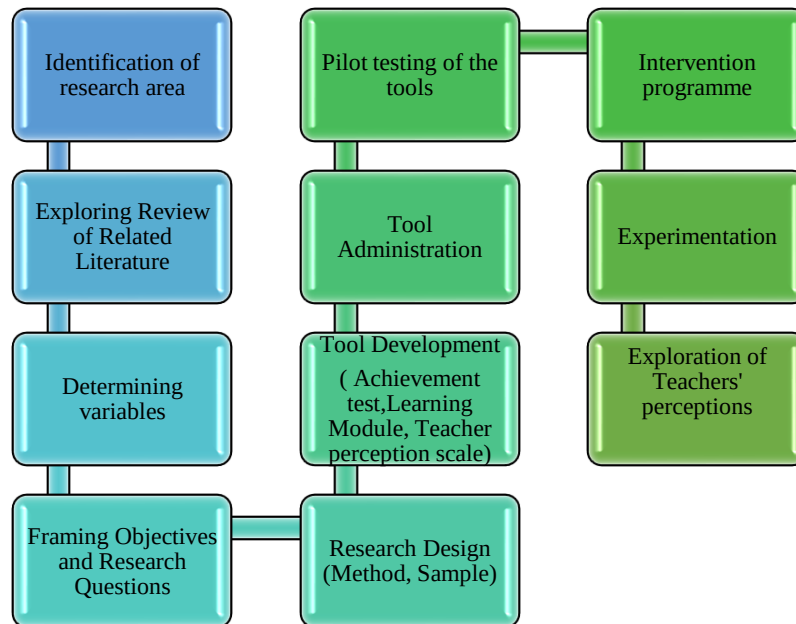


Fig3.2: Schematic Representation of Research Process

3.4 Research Method

Mixed Method research is a methodology adopted to get the study's breadth and depth of understanding and corroboration. Using various methods (data sources and researchers) to look at the same occurrence is one of the most advantageous aspects of mixed-methods research. This enables a person to approach a concept from various angles and employ a variety of tactics in order to more accurately pinpoint its aspect.

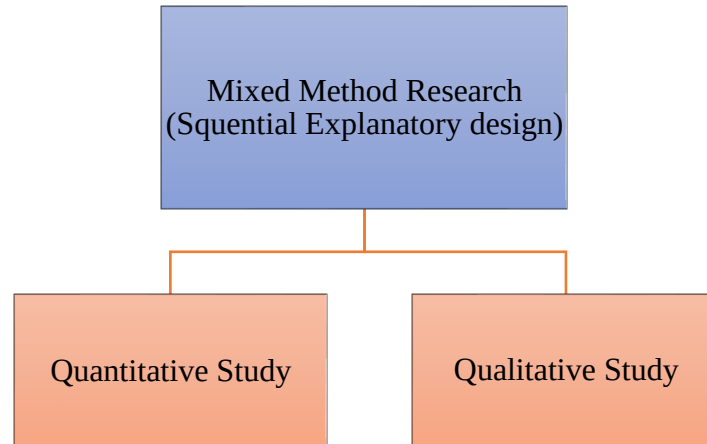


Fig 3.3: Representation of Research Method

Sequential explanatory design

This design involves the data collection and analysis of quantitative data, followed by the data collection and analysis of qualitative data. The priority is quantitative data, and the findings are integrated during the interpretation phase of the study. In quantitative research, the Quasi-experimental method- Single group pre-test and post-test design has been taken to find the difference in the student's academic achievement for effective conceptualization through arts integration in mathematics. While studying the teachers' perceptions about integrating art into the mathematics curriculum, a qualitative study has been done.

3.4.1 Population is the entire collection of individuals considered (McBurney & White, 2010). It designates a larger but with group similarity from which the sample is drawn (Anastasi & Urbania, 1997). Elementary school students have been chosen from Hyderabad district, Telangana state.

3.4.2 Sample

In this study, the researcher intends to determine the effectiveness of Art Integrated learning in mathematics for developing positive attitude and mathematical conceptualization among elementary students. The sample for the study has been selected in the following stages.

3.4.3 Sampling Process

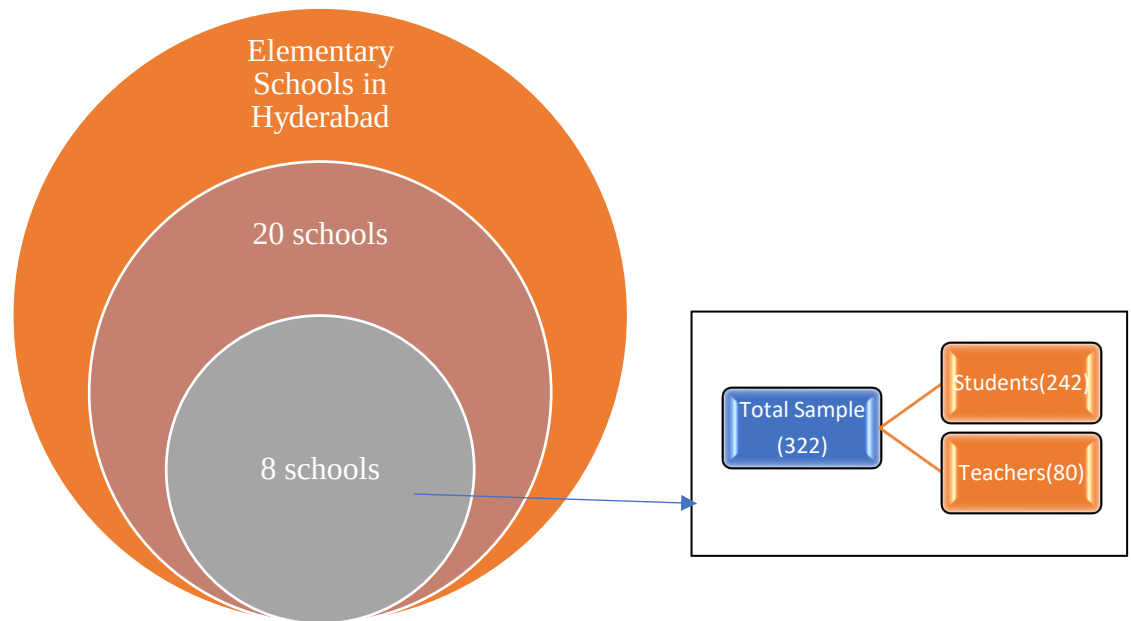


Fig 3.4: Sample of the study

The target population of the study are the elementary schools in the Hyderabad district. Probability sampling technique was adopted in the present study. 20 schools were selected using Random Sampling technique by the researcher. Out of which only 8 schools have given permission conducting experimental study in their schools.

- (i) A total of 242 students were the participants from eight different schools. The researcher in the present study has adopted a random sampling technique. Students were taught by the researcher and their

teachers; an intervention programme has been conducted for teachers on arts in education and its integration into mathematical concepts. Sixth and Seventh-grade students are selected for the research because the mathematical subject matter in this grade is no longer as playful as in the lower grades and is less frequently presented visually.

- (ii) Eighty teachers participated in the study from different schools in Hyderabad to explore the mathematics teachers' perceptions of applying arts integration strategies in teaching and learning mathematics.

The table shows the list of schools, classes taught, and the concept introduced using art forms

School Name	Class Taught	Math Concept	Art form Introduced
School 1	6	Algebra	Warli Art Drawing
School 2	6	Lines and Angles	Dance
School 3	7	Profit& Loss	Storytelling
School 4	7	Symmetry	Craftwork
School 5	7	Ratios & Proportions	Culinary art, painting
School 6	7	Exponents	Drawing, Storytelling
School 7	6	Percentages, Fractions & Decimals	Theatre arts, Puppetry
School 8	6	Data Handling	Gardening

Table 3.1 List of schools, classes taught, and the concept introduced using art forms

Based on the availability of the resources and interest of the school administration, teachers and students, the above table describes varied art forms used to teach different mathematical concepts in eight schools.

3.5 Tools:

For the present study researcher has used 4 tools

- i. One standardized Tool of Modified Fennema Sherman's mathematics attitude scale on elementary students. This tool comprises 40 items with a five-point frequency scale.
- ii. The Mathematics Achievement test for elementary students has been used in the study to know the students' conceptual understanding. It is a self-constructed tool.
- iii. Learning module has been developed on arts integration in mathematics to have a better understanding of integrating different art forms in mathematical concepts by the teachers.
- iv. The Teacher Perception Questionnaire on Arts Integration in Mathematics (TPAIM) has been developed by the researcher to know the teachers' perceptions of arts integration in the mathematics classroom.

3.5.1 Steps in the construction of Tools

The steps adopted for the construction of the tools are as follows:

Planning of tools- The questionnaire has been proposed to accomplish the objectives of the present study.

Collection of items- Initially, the accessible literature relating to the problems have been studied comprehensively to develop and form items for the tools. The researcher studied relevant theories and reports from various academic journals, relevant books and websites to get insight into the problem. These were taped to get the related literature and helped to provide a basis for the tool.

First draft – The tool has been planned as per the present research objectives. Keeping in mind all the directions and essential rules of schedule construction, the researcher prepared the first draft of the questionnaire.

Editing of the statements – Re-reading the items have been consolidated in the tools with secondary data sources. Some statements were rejected from tool, language has been improved, and a few statements were edited, reformed and deleted from the tools.

Final draft of Tool – The language errors and ambiguities identified were rectified in the final draft, and changes were incorporated in the final draft. Great care was taken for the final draft to ensure clarity of printing text, the appropriate size of letters and space adequacy. Clarity of instructions, proper layout on each paper, proper spacing between statements, adequate response space, and attractiveness have been maintained.

3.6 Description of Tools

3.6.1 Tool 1: Modified Fennema-Sherman Mathematics Attitude Scale

This tool has been re-developed by Diana Doepken, Ellen Lawsky, and Linda Padwa to give teacher and individuals helpful information about students'

attitude(s) towards mathematics at the elementary level. This tool consists of 40 items under four dimensions with a Frequency scale of Strongly Agree =5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1.

The dimensions of the tool are

1. Enjoyment of Mathematics learning
2. Motivation
3. Self-Confidence in Mathematics
4. Perceived Value in Mathematics

The researcher has chosen this tool for the present study as the dimensions mentioned are very apt for understanding the students way of thinking about mathematics in a better way.

3.6.2 Tool 2: Development of Learning Module

A learning module is an instructional tool with an innovative combination of content with other content which focuses on the concept to be learnt. The present study uses art-integrated approaches to enhance the student's learning potential and make the educational process more efficient. Document analysis of the school curriculum, textbook analysis and research literature was done while constructing the learning module, Theoretical approaches based on the National Council of Education and Research Training (NCERT) and National Educational Policy 2020 with appropriate strategies were studied. Experiential Learning theory and model given by David Kolb was the base for designing the steps in the instructional Learning Module. Art Integrated Learning model given by NCERT has been used for the learning module development. Innovative techniques in enhancing students'

learning performance concentrated on learners' self-practices and group- practices were done with teachers' supervision or coaching.

3.6.3 Tool 3: Achievement test for elementary students

According to Webber (1982), to assess the effectiveness of any discipline strategy, the primary data sources are the teacher, student and observer. In this study, special recognition has been given to the teacher, student and researcher as independent observers. An analysis of the literature on achievement tests revealed that to implement innovative teaching strategies, teachers needed both theoretical understanding and practice in specific methods or strategies. Achievement test aims to measure an individual's skill level or knowledge in a specific area. Achievement test in mathematics for elementary students has been prepared by giving due weightage to the academic standards in mathematics, such as problem-solving, reasoning, communication and connections, visualization and representation.

Table showing the weightage allotted to the academic standards

Academic standards	Marks allotted	Percentage
Problem Solving skills	13	32.5%
Reasoning	11	27.5%
Communication and Connection	9	22.5%
Representation	7	17.5%
TOTAL	40	100

Table 3.2 The forms of questions are short answer type, very short answer type and objective type.

Weightage given to different types of questions

S.No	Forms of Questions	Marks	Percentage
1.	Multiple Choice Questions	15	37.5 %
2.	Very Short Answers	7	45%
3.	Short Answers	8	17.5
	TOTAL	40	100%

Table 3.3: Types of questions

The test has been prepared based on a blueprint. Before drafting the final form, the investigator discussed with the educational experts for suggestions to modify and discard the invalid items. The final form of the test consisted of fifty items: ten were eliminated, and six were restructured. In the end, 40 items were finalized by the researcher based on the expert's suggestions. Separate answer sheets were provided to each participant. A copy of the achievement test is given in Appendix. The same test has been administered as both the pre-test and post-test. The pre-test was administered to participants in the first session and the post-test in the last session immediately after the intervention programme. The data obtained through the tests were analyzed using the appropriate statistical technique: t-test.

3.6.3.1 Pilot Study

Pilot testing of the tool has been done in two elementary schools as they have integrated a few art forms into their mathematical lessons. Subsequently, the tool has been finalized after duly getting them vetted by the experts and incorporating the suggestions given.

3.6.3.2 Validity of the tool

Face Validity

The tools are developed under the guidance of the supervisor, research experts, and educators in different fields. The tools developed were appropriate for the elementary students as they served the test's purpose items in the tool which was suitable for the sample. The tool is also clearly relevant for its intended measure.

Content Validity

For developing content validity, teachers and principals from different schools and lecturers from the department of education have worked to facilitate the tool's development. This tool has been developed for this study based on the dimensions taken according to the teacher's needs. Based on the expert's opinion, the tools possessed Face and Content validity.

3.6.3.3 Reliability of the Tool

Reliability of the tool was done using test re-test reliability and Item-Analysis of the tool. The table below describes the item analysis done for each item where the Item difficulty and discrimination index have been calculated.

Item No.	Difficulty level	Discrimination Index	Interpretation
1	0.63	0.38	Retained
2	0.68	0.40	Retained
3	0.20	0.03	Eliminated
4	0.68	0.40	Retained
5	0.65	0.35	Retained
6	0.70	0.48	Retained
7	0.68	0.30	Retained
8	0.25	0.21	Eliminated
9	0.65	0.23	Retained
10	0.60	0.25	Retained

11	0.70	0.43	Retained
12	0.60	0.35	Retained
13	0.63	0.33	Retained
14	0.65	0.38	Retained
15	0.12	-0.07	Eliminated
16	0.70	0.38	Retained
17	0.68	0.43	Retained
18	0.65	0.38	Retained
19	0.63	0.35	Retained
20	0.73	0.48	Retained
21	0.68	0.40	Retained
22	0.65	0.33	Retained
23	0.18	0.09	Eliminated
24	0.70	0.35	Retained
25	0.63	0.38	Retained
26	0.68	0.40	Retained
27	0.65	0.30	Retained
28	0.70	0.40	Retained
29	0.01	-0.02	Eliminated
30	0.60	0.30	Retained
31	0.63	0.35	Retained
32	0.65	0.35	Retained
33	0.60	0.33	Retained
34	0.63	0.38	Retained
35	0.65	0.43	Retained
36	0.68	0.38	Retained
37	0.63	0.35	Retained
38	0.28	0.29	Eliminated
39	0.65	0.38	Retained
40	0.60	0.30	Retained
41	0.68	0.43	Retained
42	0.65	0.33	Retained
43	0.24	0.01	Eliminated
44	0.63	0.38	Retained
45	0.68	0.40	Retained
46	0.63	0.43	Retained
47	0.34	0.11	Eliminated
48	0.16	0.09	Eliminated
49	0.24	0.01	Eliminated
50	0.63	0.35	Retained

Table 3.4: Item Analysis

For the selection of items, the discriminating power and difficulty level values must be determined. According to Sozbilir (2010), item difficulty is interpreted as follows; 0.80 and above - very easy; 0.65-0.79 - easy; 0.35-0.64 – moderate; 0.20 - 0.34 – difficult; 0.19 and below - very difficult. The items with difficulty level from 0.3 to 0.7 and discriminating power of more than 0.30 are considered appropriate by the researcher under the expert's suggestions. Achievement test in Mathematics possessed Difficulty Index $p = 0.67$. Test-Retest reliability has been established using the formula of Product moment correlation where $r = 0.81$. Therefore, the tool is reliable statistically.

3.6.4 Tool Construction to know Teacher Perception Questionnaire on Arts integration in Mathematics (TPAIM)

The researcher has constructed this tool to know the perceptions of the teachers on Arts integration in Mathematics classroom. The tool has been developed based on the following dimensions.

- i. Creativity and skill development
- ii. Presentation and production of conceptual understanding
- iii. Exploration and connection
- iv. Insights of the learner

The Tool is divided into three sections, they are

Section I (Q1-Q4) includes demographic information such as name of the teacher, institution name, classes dealing with and curriculum followed.

Section II (Q5-Q18) comprises closed-ended questions with 5-point scale i.e., (1= false, 2= somewhat false, 3= neither true nor false, 4= somewhat true, 5=true) with

14 items in it. This section is framed to analyze the opinion of the teachers about arts integration.

Section III (Q19-Q30) comprised open-ended questions on views of teachers in detail on how arts integration benefits student's academic achievement, Questions on instructional strategies, upgradation of professional growth, encouragement by the administration, motivation given to students, how mathematical concepts are incorporated, different art forms used in the classroom and share inspirational anecdotes in teaching process have been asked.

3.6.4.1 Pilot Study

Pilot testing of the study has been done on 12 mathematics teachers. Based on the responses given by the teachers, few modifications were made under the guidance of the supervisor and experts in the field.

3.6.4.2 Tool Validation

Face Validity

The tool has been developed under the supervisor's guidance, research experts from educators in different fields. The tool developed has been appropriate for the teachers as it served purpose of test, the items in the tool were suitable for the sample and the tool is also clearly relevant for it intended to measure.

Content Validity

For developing content validity, art teachers, subject teachers from different schools, lecturers from department of education and performing arts worked along to facilitate the development of the tool. This tool has been developed for this study

based on the dimensions taken according to the needs of the teacher. Based on the expert's opinion the tool possessed Face and Content validity.

3.6.4.3 Reliability of the Tool

Reliability of the tool has been calculated using Cronbach's formula.

$$\alpha = \frac{K}{K-1} * \left(1 - \frac{\sum_{i=0}^K s_i^2}{s_t^2} \right)$$

Where, K is the number of items,

s_i^2 is the variance of the observed total test scores,

s_t^2 is the variance of item.

The reliability value has been $r = 0.82$. Thus, the tool possessed high reliability.

3.7 Statistical Techniques:

The analysis of the data was measured both quantitatively as well as qualitatively.

Mean, SD, t-test and Karl Pearson Correlation was employed to analyse the data.

Mean, mode and standard deviation were calculated as measures of descriptive statistics whereas t-test and Karl Pearson's Correlation were employed as a measure of inferential statistics.

OBJECTIVE		Tool	Analysis Technique
1	To find the attitude of elementary students towards Mathematics	Attitude Scale	Descriptive Statistics
2	To understand the conceptualization of elementary students in mathematics	Achievement test	Descriptive Statistics

3	To develop art integrated learning module for mathematics teachers at elementary level	Learning Module	-
4	To study the difference in the attitude towards mathematics through arts integration among the elementary students.	Achievement test	t-test
5	To study the effectiveness of mathematical conceptualization through arts integration among the elementary students.	Attitude scale	t-test
6	To find the relationship between mathematical conceptualization and attitude through arts integration among the elementary students.	Achievement test and Math Attitude scale	Karl Pearson Correlation
7	To explore the perceptions of the teachers in adopting art integrated strategies in teaching mathematics at elementary level.	Teacher Perception Questionnaire on Arts integration in Mathematics (TPAIM)(Self Constructed tool)	Descriptive Statistics, Thematic Analysis

Table3.5: Objective wise tool used and analysis technique

3.8 Procedure of Experimentation

The study has been planned in Five phases.

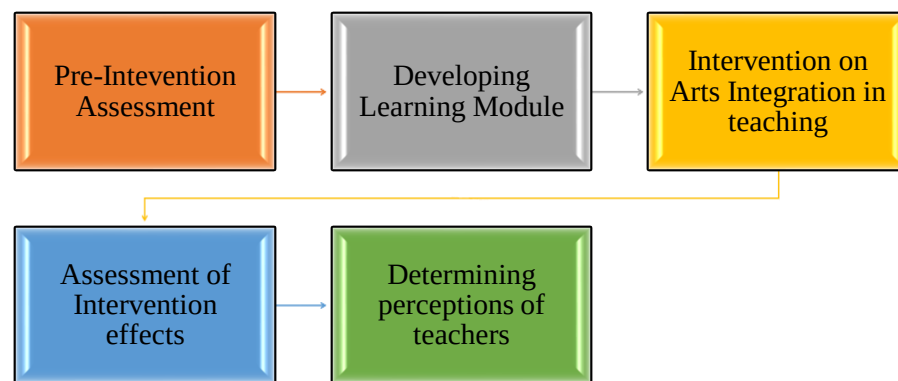


Fig 3.5: Phases of the study

In **Phase I Pre-Intervention Assessment**, students' attitudes toward mathematics were measured using the elementary-level mathematics attitude scale. Through this, the researcher has understood the student's thought process when exposed to mathematical concepts. After that, an achievement test was given to the students before the intervention programme, so their conceptual understanding level can be analyzed at the initial stage. In this phase the researcher was able to understand the student's conceptual level so that suitable intervention programme can be developed.

In **Phase II Learning Module** has been developed by the researcher for the mathematics teachers to teach innovative instructional strategies on how to introduce mathematical concepts using different artforms. Textbook analysis has been done by noting down all the mathematical concepts from different curricula such as CBSE, ICSE and SSC respectively. At this phase the concepts which are relevant in all the curricula are taken into consideration, based on syllabus in each curriculum. This has been done so that any curricula can efficiently utilize the module being developed irrespective of any board of education. Teachers are given intervention programme on art integrated learning for two days in their respective schools. They have experienced the usage of different artforms in mathematical concepts and also exchanged suggestions in the implementation process.

In **Phase III Intervention on Arts Integrated teaching**, these concepts were taught by the researcher in the mathematics classroom using the developed learning module. Students were taught in groups and as a whole depending on the concept

being taught. This has been carried in different schools for 3 to 4 weeks in each school. Total of eight schools participated in the study.

In **Phase IV Assessment of the Intervention**, students' conceptualization has been measured using the achievement test developed and standardized by the researcher. In continuation students' attitude towards mathematics has been also measured using the same Mathematics Attitude Scale. The post-test scores have been noted down.

In **Phase V Determining perceptions of teachers**, perceptions of the teachers have been analyzed by the researcher by using self-developed and standardized questionnaire on knowing the perceptions of the mathematics teachers on arts integration.

3.9 Data Collection procedure

The research method adopted in the study is Quasi Experimental study. The researcher compared scores of the students using the obtained achievement test in pre-test and post-test scores. During the pedagogical experiment, the researcher conducted intervention programme to the teachers on how to choose artforms for different concepts in mathematics and developed learning module to the teachers so that the teachers will have an understanding on how to integrate artforms into mathematical concepts. The researcher has spent few weeks in each school and taught mathematical concepts through arts integration. Researcher has taken class 6 and 7 students for the study. Students were given a pre-test before the experimentation process started. Students were tested on their attitude towards

mathematics by using Modified Fennema Sherman Mathematics Attitude scale for elementary level. Achievement test was also given to the students to know their level of conceptual understanding before teaching the art integrated concepts. Students were taught lessons with arts integration into mathematical concepts for few days. In this teaching learning process students were tested for their creative abilities. A post-test has been conducted on the same group to test their mathematical conceptualization and also an assignment has been given to develop a concept using any art form. Attitude has been tested again after completion of the post-test. All the scores were noted by the researcher. Perceptions of the teachers towards art integrated teaching and learning has been taken using self-developed questionnaire. The data has been collected at the end of the experimental study. In order to find the perceptions of the teachers about the arts integration questionnaire has been analyzed. Interpretations will be made based on the results obtained.

3.10 Analysis

The analysis of the data was done both quantitatively and qualitatively.

Tool-wise analysis is given as.

- **Attitude Scale:** The analysis of the responses obtained through Mathematics Attitude scale has been done statistically. All the pre-test and post-test responses were fed into the SPSS and Paired t-test has been used for statistical analysis.

- **Achievement test:** The students' pre-test and post-test achievement scores were entered into the SPSS data sheet and paired t-test was applied for statistical analysis.
- **Teacher perception questionnaire:** This Tool has been analyzed both quantitatively and qualitatively. Quantitative analysis like mean, mode, standard deviation and percentages were applied to know the frequency of the responses being given by the teachers. In Qualitative Analysis Thematic Analysis has been done to have deeper understanding of the responses given by the teachers.

Description of Thematic Analysis

Thematic Analysis has been used for analyzing responses given by the teachers. According to Braun and Clarke 2006, Thematic analysis has been presented in 6 steps.

Steps	Description
Familiarizing with the data	The first step is to know about the data. It is essential to get a thorough overview of all the data that has been collected before the researcher starts analyzing individual items.
Generating Initial Codes	The researcher needs to code the data. Coding means highlighting text sections, usually in phrases or sentences, and then coming up with short labels or "codes" to describe their content. The researcher then collates all the data into groups identified by codes. These codes allow to gain a condensed overview of the main points and ordinary meanings that recur throughout the data.

Searching for themes	The researcher transcribed the codes being created, identified patterns among them, and arrived at themes.
Reviewing themes	The researcher had to ensure that the themes are viable and accurately represented the data. The researcher returned to the data set and compared themes against it. If encountered problems with the themes, they can be split, combined, discarded or created new ones: whatever makes them more valuable and accurate.
Defining and Naming themes	Defining themes involves formulating precisely what the researcher meant by the theme generated. Then figuring out its usage to understand the data. Naming the themes with a succinct and easily understandable which gives prior description for each theme.
Interpretation of the themes	Themes were generated identified based on the frequency of the responses from the transcripts. Based on the theme generated explanation of the theme is given in detail.

Table 3.6: Thematic Analysis Description by Braun and Clarke

CHAPTER IV

ANALYSIS AND INTERPRETATION

4.1 Introduction

The previous chapter dealt with the description of method, population, sample, tools and techniques. This chapter discusses the quantitative and qualitative analysis.

The researcher's aim of analysis is to transform data into an understandable and interpretable form so that the relationship between research variables can be explored. The mean, mode, standard deviation, percentages, correlation, and t-test were among the particular statistical methods used for the data analysis. To find out the extent of practice of art integrated learning pedagogy by the students, to study and compare the academic scores and attitudinal scores of the student's, percentages and t-test has been computed. To determine the average of teacher respondents about arts integration, mean was computed. To determine the frequency of the responses given by the teachers' mode was computed. To determine the variability of the scores standard deviation has been computed. To study the perceptions of the teachers regarding the possibilities and obstacles in adopting art integrated learning pedagogy in actual classroom, analysis of the responses obtained through questionnaire was done in qualitative terms using Thematic Analysis.

The data analysis and interpretation has been divided into two sections

Section I: Quantitative Data Analysis

Section II: Qualitative Data Analysis

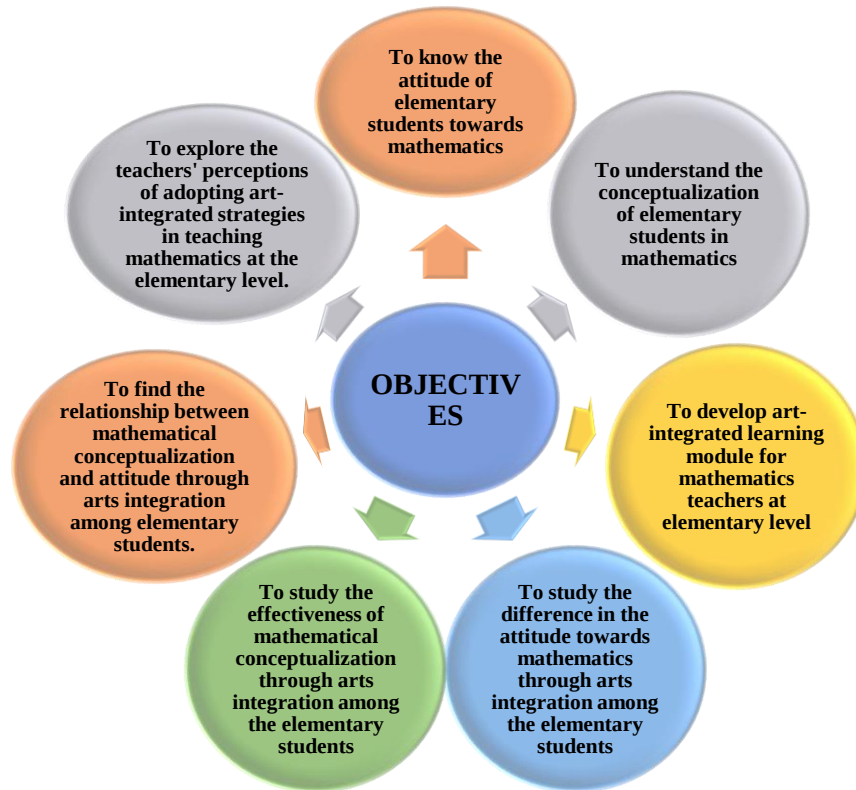


Fig 4.1: Objectives of the Study

4.2 SECTION I: Quantitative Analysis

Obj 1: To find the attitude of elementary students towards mathematics

Hypothesis 1: Most of the elementary students have a moderate attitude

Based on the responses obtained from the elementary students on Mathematics attitude scale, the following table shows the level of attitude among the students.

Table 4.1: Percentage -wise pre-attitude scores of the students

Pre-Attitude level	Frequency	Percentage
Very High	0	0
High	8	4
Moderate	32	15
Low	153	72
Very Low	19	9
Total	212	100

Based on the above table, the percentages are shown in the form of pie-chart as follows:

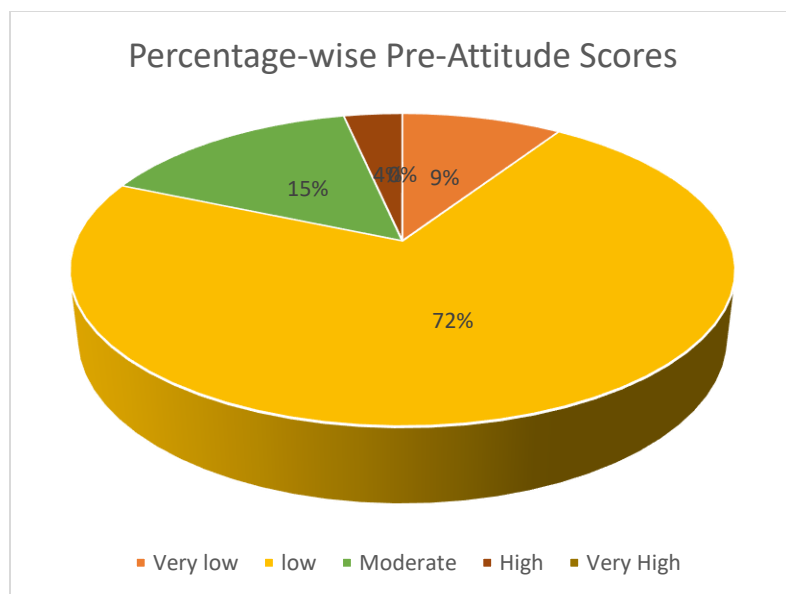


Fig. 4.2 Graphical representation of Percentage-wise pre- attitude scores of the students

Interpretation:

The above pie diagram shows that 72% of the elementary students have low attitude in mathematics, 15% of them possess moderate attitude and only 4% of the elementary students possess high attitude in Mathematics. The reason for this could be the fear among the students regarding the understanding of mathematics concepts. The students lack self-confidence in learning, understanding, and producing them during assessment. The students do not enjoy the way concepts are introduced to them in classroom without its practical application and relevance in the real world. Students lack motivation from teachers, parents and peers. Students express inability to solve difficult math problems. Thus, H_1 is rejected that is most of the students have a moderate attitude towards mathematics.

Objective 2: To understand the conceptualization of elementary students in mathematics

Hypothesis 2: Most of the elementary students lack conceptualization in mathematics

Based on the obtained scores in the achievement test by the elementary students, the scores are categorized into the following levels:

Table 4.2: Percentage-wise pre-achievement scores of the students

Pre-Achievement level	Frequency	Percentage
Very High	4	2
High	21	10
Moderate	49	23
Low	121	57
Very Low	17	8
Total	212	100

Based on the above table, the percentages are shown in the form of pie-chart as follows :

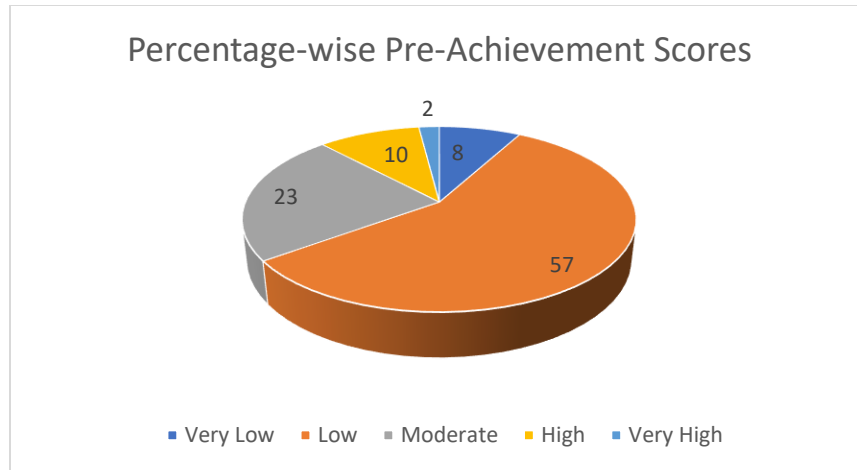


Fig 4.3: Graphical representation of Percentage-wise pre- achievement scores of the students

Interpretation:

From the above pie diagram, 57% of the elementary students have low conceptualization in mathematics. Only 23% of the students have moderate mathematics conceptualization as many students lack connections of the concepts and get confused when dealing with similar ones. Students tend to forget the concepts being taught in the previous stages and there is inability to understand the need and relevance of mathematics in the real world. Therefore, H_2 is accepted that is most of elementary students lack conceptualization in mathematics.

Objective 3: To develop art integrated learning module for mathematics teachers at elementary level.

Research Question 1: How to design art integrated learning module for mathematics teachers at elementary level?

The Learning Module has been developed based on the model of Experiential Learning process given by David Kolb. The four steps in this model are

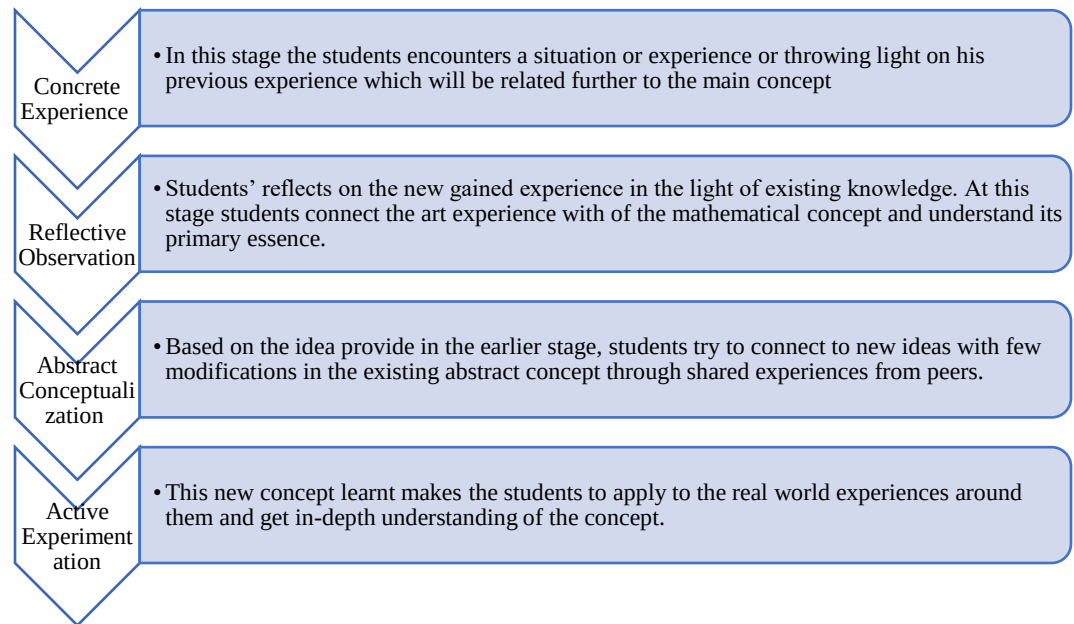


Fig 4.4: Experiential Learning Model

LEARNING MODULE

MODULE ON TEACHING MATHEMATICS THROUGH ARTS INTEGRATION AT ELEMENTARY LEVEL

Learning objectives

- Understand mathematical concepts with art-integrated lessons for better conceptual understanding
- To make learners understand the mathematical concepts in a practical way
- Enhance joyful learning in the classroom
- Organize art experiences where learners can participate in the activities and engage, explore, observe, create and express themselves without any hesitation and become self-reliant.
- Self-learning will be enhanced among the learners

INTRODUCTION TO ARTS INTEGRATION

Arts integration is a new approach to education using arts. This will integrate the different art forms into the school subjects of the curriculum. It fosters intercultural dialogue, mutual understanding, and social inclusion among children. Art can be used to teach or learn a subject as a medium of education. Art based approaches can be used in teaching and learning processes to impart quality in education. Students can use arts as forms of reflexivity to highlight various aspects of the subjects they are learning.

Art should be introduced in schools to ensure a harmonious development of the individual, to bring forth his abilities, innate talents and faculties and instincts. Arts integration is of great importance for the student's all-round development, Intellectual, social, psychological, educational and moral development. This will train the observation power to see accurately, to make one realize the value of accuracy and to encourage child's natural impulse to give a visible form to his ideas and make him aware of what is beautiful in nature and its interdisciplinary to the curricular subjects.

PRINCIPLES OF ARTS INTEGRATION

Principle of Tenacity

This approach should be tenacious and should have some main objective. The objective should give enthusiasm and work to the learners with their talent.

Principle of Effectiveness

This approach is helpful to learners and society. It ought to add some value to the thought process. The effectiveness has a deeper understanding of curricular subjects and its application-based learning to be in focus.

Principle of Choice

The students should be given the option to choose an artistic medium for a given subject and to complete the task in accordance with their own preferences, interests, attitudes, and abilities. The instructor should only serve as a "guide on the side" and provide direction for creative execution.

Principle of Creativity

The learners must, at the conclusion of the project, acquire knowledge through creativity because arts integration is a deliberate activity. Additionally, it is a requirement of the learning-by-doing concept.

Principle of uncertainty

This method needs to be certain and relevant to the learners' and society's daily lives. Then and only then would they be able to comprehend and use easily. This entirely relies on the creativity and talent of the learner.

Principle of Skill Development

This focuses on societal needs, social development, and becoming self-reliant among every individual. Learning an art form, imbibing a talent and integrating to their academic learning makes the education more simpler and worth being educated.

NEED FOR ARTS INTEGRATION IN MATHEMATICS

The most important element in learning is the educator or teacher, who is an integral part that contributes significantly to the process of instruction and learning both inside and outside of the school. Teachers have always worked to develop their students' social and personal skills in order to form them into people of character (virtuous, with social character as the main goal of learning itself). From elementary education to university, mathematics is one of the subjects that is taught with a focus on developing fundamental knowledge. Knowing mathematics is a

skill that students can use to comprehend and address issues in society, economy, and the natural world. The assumption made by the majority of these students that mathematics is a difficult topic may not be overstated because understanding one concept before moving on to another is necessary. Understanding a concept is particularly important because understanding the previous lesson makes understanding the subsequent lesson simpler. As they study mathematics, students should actively understand how to construct new knowledge from previous knowledge and experience. The development of mathematical concept comprehension is essential because it is linked to the concept-planting process. In order to avoid boredom and make learning enjoyable for the students, an appropriate method or set of methods must be used to teach mathematics. Using various artistic mediums and incorporating them into mathematical concepts for effective conceptualization is one method to achieve this.

Learning Objectives:

- Understanding of art as a pedagogical tool in the classroom;
- To know the effects on a child's overall development;
- Familiarity with art experiences as a means of creative self-expression; and
- to plan and coordinate age-appropriate art experiences to make learning about various subjects interesting.

Activity I

Class VII

Topic: Powers and Exponents

Introduction to the chapter:

We use multiplication to shorten the representation of repeated additions by writing 5×4 , 6×5 and 8×7 respectively. Repeated multiplication of a number by itself can be expressed in a simpler way. This is known as exponential form. Large numbers can be expressed in easier way to read, write and understand.

Example: The speed of light in vacuum is 30,00,00,000 m/sec. This can be expressed as 3×10^8 . 10^8 is said to be exponential form and it is read as 10 raised to the power of 8.

Key concepts: Exponent, power, prime factorization

Learning outcomes

- Writes the large numbers in exponential form by using prime factorization.
- Generalizes exponential laws through the observation patterns
- Understands the meaning of x in a^x where $a \in \mathbb{Z}$
- Expresses the large numbers in standard form

Materials required: Chart paper, Colours

Method: Artform used is Drawing and Painting and Story-Telling

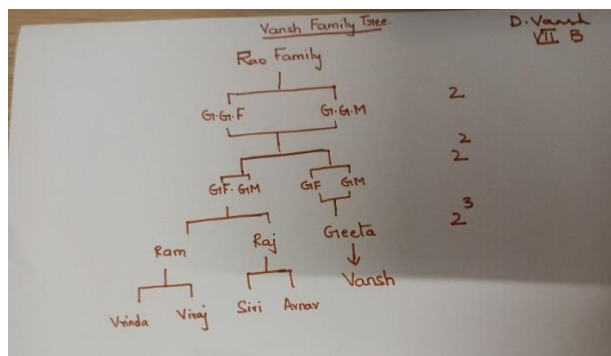
Steps for instructional designing

1.Creative skill of the students

Teacher asked the students to describe about the members in their families. Asked each child to draw a family tree in detail. Students presented this activity very creatively as few have shown in the form of tree, few students has shown in the form of sheep herd, few of them in the form of geometrical shapes. Teacher made the students into different group based on the members in their family. Each group has given few tasks to be done.

2.Presentation and production of the conceptual understanding

Students were asked to observe the pattern how the family started with how many members and how it started multiplying into more members in the family. Each family consisting of father and mother were considered as one pair with two members. Depending on the kids they have, the pairs started increasing. This was shown in pictorial representation by the students. Here the students were introduced the concept “Exponent”. This pictorial representation was converted into numerical representation with the help of Exponent. When each pair consists of two people we call it a “Base”. As the family expands with children forming more pairs than it is said to be the power depending on number of children. Students were able to analyze the conceptual understanding of the concept taught as it was related to their families.



Representation of Exponents through Family tree

3.Exploration and Connection

Teacher will give description of each groups family tree and converted them into exponential form. Now students were asked to explore more on taking large numbers and present its exponential form. Teacher has taught how vast distances are represented with base 10 and their exponents.

4.Insights of the learners

Students had enjoyed the way the concept was taught. They had gained knowledge about the term exponent, power, base, and prime factorization. Students has learnt the representation of distances between larger bodies through exponents.

Assessment

1. Representation of repeated addition in shorter form can be done through_____.
2. The population of Bihar is 10^8 , 10 is called _____ and 8 is called _____.
3. The distance between the sun and earth is 15,00,00,000 km, write its exponential form _____.

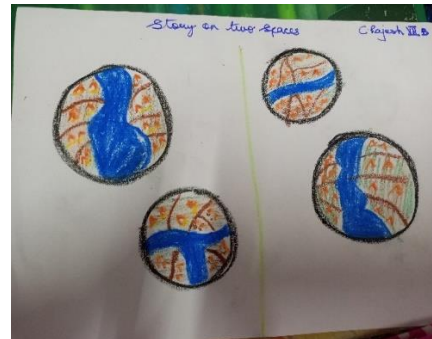
4. Which is greater 3^4 or 4^3 ? Explain?

Class project: Representation of exponential form through your creativity outside classroom?

Students Response: Exemplars.



Student shows the example of Story about a farm. There are three sheep pens. Each sheep has three lambs. This story represents the exponential form of 3^3 .



Students shows the story of two spaces. Each space has two continents. Each continent has two countries and each country has two communities with each having two houses. This story represents the exponential form of 2^6 .

Value Based Learning with Aesthetic sense

The students who belong nuclear family understand the importance of their grandparents and affection in joint families. The importance of every person in the family is well understood. While doing this activity, the communication with their grandparents has cherished their past memories and a new hope is created in the tender minds to plan for their future.

Role of the teacher

Teacher acts as a guide in making the students to accomplish the task on their own with a push from behind. It is in the hands of the teacher to the students visualize the conceptual understanding and this can be done only when a relation is built between the student and teacher apart from their role and responsibility. Relating to practical aspects will come the students understand the concept in a better way. Teachers help the learners to become more well-rounded and capable individuals.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity. Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

ACTIVITY 2

Class: VI

Concept: Algebra

Introduction to the chapter:

One of the most significant areas of mathematics is algebra. The use of letters or an alphabet to represent numbers is the primary characteristic of algebra. Any number, not just one specific number, can be represented by a letter. It might represent an undefined amount. By mastering the technique of determining unknowns, we create strong tools for resolving conundrums and numerous issues in daily life. We are aware that variables can have a range of values because, despite being numbers, they do not have a set value. As a result, we require the ability to perform addition, subtraction, multiplication, and division on them. In any real-world circumstance, we can describe relationships using variables. We can indicate a variable with any letter, including a, b, c, m, n, p, q, and x.

About Warli Art: One of the earliest types of Indian traditional art, Warli originated in the Warli district of Maharashtra. Geometric shapes like circles, triangles, and squares are primarily used in this style of tribal art to create a variety of shapes that represent the Warli tribe's way of life and values. Warli art was once painted on walls for special events. The painting would be applied over a brown backdrop that was essentially made of cow dung cakes and mud. A mixture of rice, water, and gum was used as the white pigment to sketch shapes and figures. A spiral chain of people revolving around a single central motif is one of the most well-liked motifs in Warli art.

Key concepts: Variable, Constant, Expression

Learning outcomes

- Finds value of expression when substituting a value in place of variable.
- Generalizes given patterns and express it as algebraic expression. Converts real life simple contexts into algebraic expressions.
- Finds usage of algebraic expressions when occurring to unknown values.
- Interlinks number system with algebraic system by usage of simple contexts.
- Represents types of numbers in general form.

Materials required: Chart paper, Colours, Match sticks, Glue

Method: Artform used is Craft work and Warli Painting

Steps for Instructional Designing

1.Creative skill of the students:

Teacher welcomes the students in starting the new topic Algebra. Teacher gives match sticks and asks children to make different shapes they see around. Most of the students make triangle, square, rectangle and rhombus. Now teacher groups the students according to the shapes made by them. For instance, all the students who made triangles into one group, all squares in one group and so on. After grouping teacher asks them to count how many figures are made in each group.

2. Presentation and Production of Conceptual understanding:

Teacher asks each group to choose a leader and starts asking questions where each one should be discussed come to a conclusion and then answer the question put to them.

1. How many sticks are required to form one shape?
2. How many sticks are required to form two shapes?
3. How many sticks are required to form three shapes?
4. How many sticks are required to form four shapes?
5. How many sticks are required to form five shapes?

No. of shapes	Match sticks required (for triangle)	
1	3	$3 \times 1 = 3$
2	6	$3 \times 2 = 6$
3	9	$3 \times 3 = 9$
4	12	$3 \times 4 = 12$
5	15	$3 \times 5 = 15$

Teacher asks the students to observe the pattern being followed and guides them in understanding the concept of constant and variable, how to form a pattern. Teacher encourages varied answers from the students to check their observation skills and also the logical skills. Guides them in understanding the pattern followed. Students get attentively involved in the activity and start observing the pattern. Peer interaction makes them understand the thought process going on. They start interacting with teacher, arrive at a pattern and form a rule.

Number of match sticks required = $3m$ (where m is variable) As the value for variable changes the number of matches required also changes. Students understand the concept of variable (A variable can take any value such as 1,2,3,4,5,..., which cannot be fixed).

3. Exploration and Connection:

From the above table students understand that there is a relation between number of match sticks required and the number of shapes. Students understand the relation and learn to form a rule. Teacher gathers all the students and makes them stick the shapes made on a big chart paper by forming a warli art. Teachers also discuss the history of warli art and also the aesthetic sense in the artform. Students enjoyed learning the basic concepts in Algebra with Warli artform.

4. Insights of the learners:

Students enjoyed learning about the new art form and its history. They made small art works with their creativity imbibed in it and application using problem solving techniques. Students explored the conceptual understanding of algebra and framed word problems.

Assessment

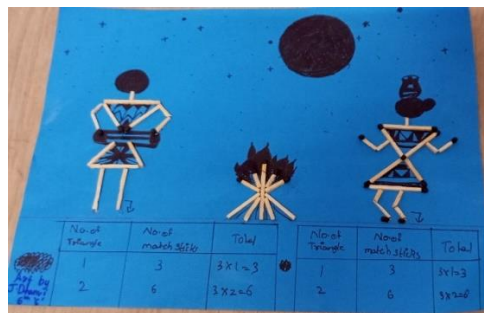
1. Find the rule for the required number of match sticks to form a pattern repeating letter 'E'?
2. Complete each table to generate functional relationship

a	1	2	4	-8	10	
$3a+2$						62

3. Complete the following expression using the given situations

S. No.	Situation	Variable	Statement using Expression
i.	'n' divided by 8		
ii.	Rs. 6 more than what Raj has		
iii.	Perimeter is 4 times the side in square	s is a variable	$4*s$
iv.	Price of apple is thrice the price of lime		
v.	Rani's height is 2 feet less than Rohit's height		
vi.	I have scores $\frac{1}{3}$ of the runs scored by you		

4. Express any equation using warli art



Students represented simple algebraic expressions using Warli Art



Value Based Learning with Aesthetic sense:

Students were able to understand the importance of unity among the tribal community in celebrating and working together. Students found the beauty in the warli art of how people, things, animals were presented in a simple and pleasant way.

Role of the teacher

Teacher has made the students to understand the mathematical concept with practical application. Teacher should be confined to one subject only here the culture and tradition is taught; Moral values are imbibed among students. Collaborative work is taught in the classroom. Peer learning as well as peer tutoring is encompassed as a whole.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity.

Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

Activity III

Class VII

Topic: Data Handling

Introduction to the chapter:

Data is information that is presented as figures or words and aids in decision-making or inference. The two main formats for presenting statistics are tables and graphs. Observations are the numerical notes in the data. A data set's representative numbers are its mean, mode, and median. The sum of all the observations in a data collection divided by the total number of observations is the arithmetic mean, or mean. It is situated halfway between the data's lowest and highest numbers. The most common observation is referred to as the mode of the data. A data collection might contain one or more modes, or it might not. When all observations are arranged in ascending or descending order, the median is essentially the middle observation. Following that, the data is displayed using bar graphs, pictographs, and histograms.

Key concepts: Data, Mean, Median, Mode

Learning outcomes

- Organization of raw data into classified data.
- Tabulation of the data is done in an organized form.
- Solves the problems for finding mean, median, mode for ungrouped data.
- Understands the mean, median, mode and what they represent.

- Explains the usage of mean, median, mode in daily life.
- Represents the data through bar graphs, pictographs and histograms.

Materials required: Pen, paper, small land for gardening

Method: Art Integrated Approach, Artform used is Gardening

Steps for instructional designing

1.Creative skill of the students

A small portion of the ground can be chosen in the playground, which receives sunlight but away from big trees. The portion of land chosen can be divided into four more smaller components. Each part is handed over to the students, who are grouped into four. Each group will be given different plant seeds. Under the guidance of the teacher and a school gardener, students can be helped in sowing the seeds and the following activity.

2.Presentation and production of the conceptual understanding

Each group will be assigned the following work which has to be carried for 15-20 days depending on the growth of the plant.

Group	Task
1	To Note down the temperature of the day for fifteen days
2	To measure the size of the plant growth daily and make a note of it
3	To prepare a line graph on the basis of the plant growth under the supervision of the teacher
4	To note down how much time was spent in the ground per day in minutes.

From the data collected teacher will give the following explanations

Group 1	Most of the temperatures noted were repeating. Based on this the concept of MODE can be taught
Group 2	Even though all seeds were sowed at the same time, growth of plants varied and the concept of MEDIAN can be introduced
Group 3	How to plot the points on the graph and how they can be presented
Group 4	Based on the time spent in minutes teacher taught the concept of MEAN to know the average time spent per day

3.Exploration and Connection

Students have learned the measures of central tendency in an easier way. Students were able to distinguish between the grouped data and the ungrouped data. The purport of each central tendency and when to utilize them have been clearly explained and understood. The connectivity of these with that of their progress cards has been analysed.

4.Insights of the learners

Students were able to plot their four Formative assessment marks on the graph sheet and analyse their progress. They additionally developed an interest in gardening and the essentiality of the plants being taken care.

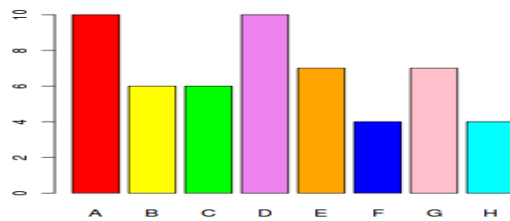
Assessment

The height data of a class is represented in the table below. Plot the bar graph to show a pictorial representation of the Data.

No. of Students	Height (in cms)
4	150
3	151
6	152
5	153
6	154
2	155
1	156

Class project :

In a class of 38 students, each students' has chosen their favorite color. The class leader wants to find out which colour has been opted by the students more frequently. Calculate the suitable measure of central tendency and represent it through bar graph.



Value Based Learning with Aesthetic sense:

Students have understood the importance of Agriculture and the effort needed to grow a plant. The importance of natural resources has been discussed. While noting

down the data students were waiting for the plants to grow faster. The type of land being used was also discussed with them. Students were overjoyed when they have noticed the growth of the plant observed the beauty in it.

Role of the teacher

Teacher played a very important role in this learning. She has enriched the knowledge of not only data handling but also about the types of soil being suited for the crop used. The importance of natural resources, protecting from other weeds etc. made the learners to learn in the natural environment. The teacher guided the students in gathering the data, organizing it and how to find the mean, median, mode and its graphical representation was taught very clearly.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity. Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

Activity IV

Class VII

Topic: Ratios and its Applications

Introduction to the chapter:

An organised comparison of amounts of the same units is a ratio. The ratio is represented by the sign ":". The expression "a:b" denotes the ratio of two numbers, and is translated as "a is to b." The terms of the ratio are the two numbers "a" and "b." In this case, the word b does not equal zero. First word or antecedent refers to the first quantity, "a," and second term or consequent refers to the second quantity, "b."

Two ratios are said to be in a percentage when their ratios are the same. The concept of proportion aids us in finding solutions to a variety of issues in everyday life.

Key concepts: ratio, proportion

Learning outcomes

- Recognize and apply ratios and proportions to solve real-life problems.
- Solve for any unknown component.
- Express quantities as proportions of each other using fractions, decimals, ratios and percentages.
- Divide quantities into a given proportion

Materials required: Colors, brushes, papers

Method: Art Integrated Approach, Drawing and Painting

Steps for instructional designing

1.Creative skill of the students

The teacher composed four groups in the class and asked them to paint a portion in their records. Each group was given three primary colors (Red, Blue, and Yellow), two syringes, a mixing tray, and a stirrer. Syringes were given to ensure the precision of the volume of colors to be used to amalgamate. This is highlighting the need for mathematics precision

2.Presentation and production of the conceptual understanding

Each group's task was to make secondary colours (Green, Orange and Purple) to properly measure primary colors. Students commenced quantifying five yellow colour components and one part of blue colour into a container utilizing syringes mixed. After obtaining the secondary colour they painted the colour into the square provided in the record sheet. They documented it by designating the colour which denoted the ratio(3:2) and how they worked. The students' progressed by incrementing the volume of colours to obtain precisely the same shade as documented earlier with its ratio indited. The student discussed in groups and made decisions about the mixture of colours prior; they then created the colour and completed the associated record sheet. During this task, both the math and art teachers moved around the groups and enquired about creating colours with suitable measures. Based on the first outcome, similar tasks with different quantities were assigned to the students.

3.Exploration and Connection

Students were able to take the colors and mix them according the proportions given by the teacher. At the initial stages they were getting either light shade or dark shades of colors but in later stages they were able to obtain the color which was apt. Under each color students have mentioned their ratios so that it was easy to identify and understand the concept.

4. Insights of the learners

Students who were unable to solve quandaries in the classroom were able to understand the concept of ratios. Few students were very fast in mixing the appropriate quantities and moved ahead by incrementing the quantities. Few students took much time understanding where they have gone erroneous and repeated the task until they succeeded. In the end, the teacher got a positive response from the students as the task was engaging, promoted understanding, and made the students realize that transmutation in the ratio of quantities would result in an incorrect mix obtaining different shades of colours. This task allowed the students to have a conceptual understanding with creativity, reasoning, and an interdisciplinary approach. The task had the potential to promote hands-on exploration and blissful learning among the students.

Assessment

1. To make green paint, a painter mixes yellow paint and blue paint in the ratio of 3:2. If he uses 12 litres of yellow paint, how much blue paint did he use?
2. Find the ratio of number of textbooks and number of notebooks in your bag?

Class project:

Prepare tea at home for your family members. Write the process stepwise.

**Value Based Learning with Aesthetic sense**

Students learnt the concept of ratios and its application in real life. They enjoyed the class and amazed how different shades of colors are formed using primary colors. The colors in the nature made them understand the beauty in it. Students have learnt how to prepare tea at the same time learnt how to help their mother at home. Safety measures while cooking was also discussed.

Role of the Teacher

Teacher made the students understand the concept of ratio and how they are used in daily life. Teacher played the role of the facilitator, assisting students through the learning process and providing them with guidance. The teacher used different methods to draw the students into the concept and made them a partner in learning.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity.

Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

ACTIVITY V

Class: VI

Concept: Volume and Capacity

Introduction to the chapter:

The quantity of three-dimensional space occupied by any matter is referred to as its volume. Any material that is a solid, liquid, or gas will absorb it. It calculates the total area of the specified closed surface.

The length, breadth, and height of an object are multiplied to determine its volume. V is expressed as $l \times b \times h$ in cubic measures (cubic litres, cubic meters, cubic centimetres, etc).

The ability of the hollow object to contain a substance that is either solid, liquid, or gas is referred to as capacity. It is referred to as a measure because it determines how much room there is in a receptacle that can be filled with the substance. In other words, the container's capacity refers to the total quantity of material that it is capable of holding. Metric units such as gallons, millilitres, litres, kiloliters, and other units are used to quantify capacity.

Key concepts: Volume of 3D figures, metric units

Learning outcomes

- Explore the properties of volume and capacity with its calculations.

- Discover the relationship between volume and capacity, the formulas for calculating them, and practice examples to hone calculation skills

Materials required: Pen, paper, small land for gardening

Method: Art Integrated Approach, Artform used is Story Telling

Steps for Instructional Designing

1.Creative skill of the students:

Students were made to sit in groups and each group was given different shape of vessels. were placed in front of them. A few stones were kept beside them. They were asked recall the story of ‘the thirsty crow’. Students were eagerly observing the things in front of them.

2. Presentation and Production of Conceptual understanding:

The teacher brought a pot filled with little water and few pebbles. The teacher dropped one by one pebble and made the students visually examine that the water level increases. Then the teacher asked the reason for a change in the water level. This act engendered the students to cerebrate and understand that the pebbles dropped in the pot, pushing the water upwards and thus increasing the water level. The space occupied by three-dimensional objects is kenneed as volume. Based on the shape of vessel placed in front of the groups, they were asked to place the pebbles in the vessel up to the brim.

3. Exploration and Connection:

The teacher showed these three-dimensional figures (cube, cuboid, cone, cylinder, sphere, and pyramid). They explained the reason for naming it as three-dimensional figures length, breadth, and height. Volume is quantifiable in cubic units. The teacher made the students calculate the volume of their water bottles and tiffin. Therefore, the concept of volume is made clear to every student in the classroom.

4. Insights of the learners:

Relating mathematical concepts to genuine-life situations increases the intellectual competency of the students. Teaching through storytelling grabs the attention of the students and increases the concentration level. It makes the classroom stress-free and gives space for genuine learning with experience.



Assessment:

Q1. Complete the following statements by filling in the blanks.

(a) Volume of a cuboid = _____ $\times$ _____ $\times$ _____

(b) Forty cubes just fit into a cuboidal box. Each side of the cube is 1 cm. Hence, the volume of the box is = _____

Q2. How many cubic centimetres is equal to one cubic metre ?

Q3. What is the volume of a storage bin that Kishan got made for storing grain, if it is 2 m long, 1.3 m broad and 1.8 m high?

Class Project: Fill the table by measuring appropriately the given capacity.

Quantity of liquid to measure	1 litre	500 ml	200 ml	100 ml	50 ml
(i) 950 ml of milk		1	2		1
(ii) 650 ml of water					
(iii) 5 litres of petrol					
(iv) 80 litres of petrol					
(v) 10 litres of diesel					
(vi) 5 l 100 ml of varnish					



Value Based Learning with Aesthetic sense:

Students were able to distinguish among 2D and 3D shapes. Through narrating a story, they have understood that hard work paves way to success. Students were completely engrossed into the story, and this made them to connect it to the daily happening around them. Irrespective of the shape of the container students were able to identify the capacity of it.

Role of the teacher:

Teacher made the students to understand the concept in a better way with in-depth understanding. This enabled the students to enhance their reasoning and connectivity competency. Finding volume of any figure was made simpler to the students.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity.

Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

Activity VI

Class : VI

Topic: Lines and Angles

Introduction to the chapter:

The fundamental geometric forms are lines and angles. Infinite points that stretch infinity in both directions make up lines, which are geometric figures. Straight lines with little depth or breadth are present. You will learn about a number of lines, including transversal, intersecting, and perpendicular lines. A figure called an angle is one in which two rays originate from the same spot. Any structure in geometry is built upon lines and angles. Without using lines and angles, it is impossible to draw a two-dimensional to three-dimensional form. Therefore, understanding the meanings of both words is crucial.

Key concepts: Types of lines, Types of Angles

Learning outcomes

- Compares the length of line segments by estimation and verification
- Classifies and differentiates the given angles
- Estimates the type of given angles

Materials required: Any prop for dance, costume

Method: Art Integrated method, Artform used is Dance

Steps for instructional designing

1.Creative skill of the students

Lines and Angles is one of the Mathematical concepts can be introduced to students by teaching them Dance. This concept can be visualized by the positioning the students in the playground. Through basic dance, the learner can create lines, shapes, and angles on the playground in groups and present a dance show on the stage. Depending on the angle being formed the creative skills of the students can be presented on the stage. At the same time, different types of lines such as transversal, parallel, and intersecting lines can be taught to the learners by this visual art form.

2.Presentation and production of the conceptual understanding

Students were assembled in the open space. Teacher showed each type of angle and its posture visually. Students followed and practiced the angles formed. Few students who are trained dancers were made to dance on the music and the other students observed, noted the different angles formed by the trained dancers.

3.Exploration and Connection

Students have learnt how different angles are connected to daily things around. They have practiced few steps from their peers and have showed interest in learning more.

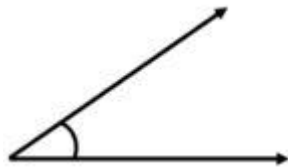
4.Insights of the learners

Students enjoyed the session as they have learnt the concept through dance. They were able to visualize the concepts and were also able to know its real life applications. Relating the types of Lines and angles to its usage made them understand the concepts in a better way.



Assessment

1. What kind of angle is this?



- a) Right
- b) Obtuse
- c) Acute
- d) None of these

2. What kind of angle is this?



- a) Right
- b) Obtuse
- c) Acute
- d) None of these

3. What kind of angle is this?



- a) Right
- b) Obtuse
- c) Acute
- d) Reflex

4. What kind of angle is this?



- a) Right
- b) Complete
- c) Acute
- d) Reflex

5. One complete angle is equal to _____ right angles.

- a) 1
- b) 2
- c) 3
- d) 4

6. 79.5° is a right-angle angle. Mark True / False.

- a) True
- b) False

7. 360° is a complete angle. Mark True / False.

- a) True
- b) False

8. 187° is a straight angle. Mark True / False.

- a) True
- b) False

9. 90° is a right angle. Mark True / False.

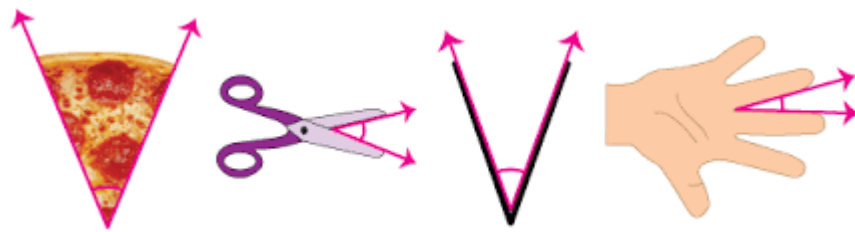
- a) True b) False

10. Two angles having the same measure are known as congruent angles. Mark True / False.

- a) True b) False

Class project

List out the 5 daily life situations where you observe different types of angles and name them.



Types of angles in daily life

Value Based Learning with Aesthetic sense

Students were able to visualize the beauty in the concept being thought. They observed and practiced through dance and were able connect the mathematical concepts to the real world.

Role of the Teacher

Teacher made the students to understand the concept in a better way with in-depth understanding. This enabled the students to enhance their reasoning and connectivity competency.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity. Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

ACTIVITY VII

Class: VI

Concept: Symmetry

Introduction to the chapter:

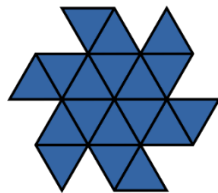
The idea of symmetry is a geometrical one that appears in most contexts, including nature. Symmetry and asymmetry can be applied to any geometric form. If an imaginary line passes through a shape, dividing it into two halves, and if the two halves fully overlap each other, the shape is said to be symmetrical or fold the shape around the fictitious line to see if the two halves fully cover one another. The shape is symmetric if they fully overlap each other; otherwise, it is asymmetric. The symmetry line is a hypothetical line that exists. Any point on a shape with point symmetry has a corresponding point that is precisely the same distance from it. The imaginary line is called as the line of symmetry. Any point on a shape that has point symmetry has a corresponding point that is precisely the same distance from the point of symmetry as it is in the opposing direction.

Rotational symmetry: When a figure is rotated around a central point, it retains its original appearance.

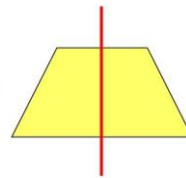
Center of Rotation: Static location where movement revolves

Rotational angle: During spinning, the turning angle

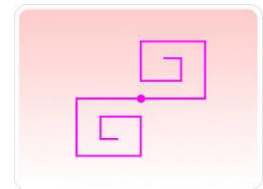
Order of Symmetry: Number of angles at which an image can be rotated and still retain its original appearance.



Rotational Symmetry



Line Symmetry



Point Symmetry

Key concepts:

Learning outcomes

- Students will be able to name and recognize the three different types of symmetry: reflection, rotational, and point
- Identify a shape's line of symmetry
- Identify a shape's order of rotation
- Create an image with point symmetry using graph paper

Materials required: Colour papers, Scissors

Method: Art Integrated method, Artform used is Paper Craft

Steps for Instructional Designing

1.Creative skill of the students:

Students were given different coloured papers and were asked to make different shapes of their own.



Students working on paper cutting and analysing the concept of symmetry

2. Presentation and Production of Conceptual understanding:

Based on the shapes made by the students, they were asked to fold the paper in the middle in such a way that the folded part should be of equal size. With this, students were taught the line of Symmetry. Shapes such as circle, oval, flower were made to rotate at 45° angle and 90° angle. Students made different shapes and were eager to find the line of symmetry. Few students did not have line of symmetry depending on the shape cut by them.

3. Exploration and Connection:

Students were able to explore the types of symmetry to different shapes and were taken out of the classroom to observe more natural things around them. They collected leaves, petals, stones and observed many other things in the school premises.

4. Insights of the learners:

Students were excited in learning the concept of symmetry through paper craft.

They were able to relate the new terms to different things they observed.

Assessment:

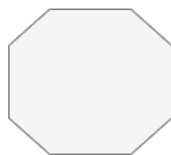
1. In the word "MATHS" which of the following pairs of letters shows rotational symmetry

- (a) M and T
- (b) H and S
- (c) A and S
- (d) T and S

2. How many letters in the word SNAIL have line symmetry?

- (a) 2
- (b) 3
- (c) 4
- (d) 1

3. Order of rotational symmetry of



- (a) 6
- (b) 4

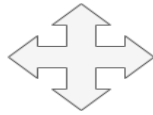
(c) 8

(d) 2

4. Which of the following figures do not have line symmetry?



(a)



(b)



(c)



(d)

5. State true or False

(i) When an object rotates, its shape changes.

(ii) If a shape possesses rotational symmetry, it will surely have a line of symmetry.

(iii) We cannot have a rotational symmetry of order more than 1 whose angle of rotation is 23°

(iv) A pentagon which has more than one line of symmetry must be regular.

6. Fill in the blanks

(i) A line segment is symmetrical about its _____.

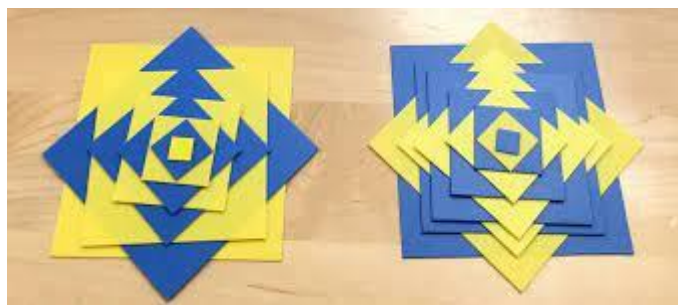
(ii) Rotation turns an object about a fixed point. The fixed point is called _____.

(iii) Each of the letters H, N, S and Z has a rotational symmetry of order _____.

(iv) The line of symmetry of an isosceles triangle is its _____
from the vertex having the equal sides.

Class Project:

Make 3D figures using the different shapes and check whether they possess line symmetry, point symmetry and Rotational symmetry.



Value Based Learning with Aesthetic sense:

Students observed and learnt different paper cuttings, they observed the leaves, flowers, snails near the plants and the beauty in it, wondered how natural things made by God are so perfect.

Role of the teacher:

Teacher made the students to understand the concept in a better way with in-depth understanding. This enabled the students to enhance their reasoning and connectivity competency.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They

will be able to look at multiple ways in solving problems through their creativity. Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

ACTIVITY VIII

Class: VII

Concept: Profit and Loss

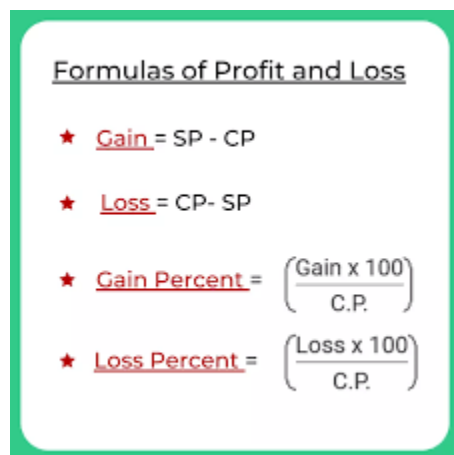
Introduction to the chapter:

The words "profit and loss percentage" are used to describe the percentage of profit or loss that has been incurred. It should be noted that one technique for comparing two quantities is the percentage. The ones that involve purchasing and selling items are the most frequent. One can make a profit or incur a loss when selling a product, and these outcomes are typically expressed as percentages.

Purchase Cost (CP): Cost price is the amount at which we bought the object. CP is used to refer to this.

Purchasing Amount (PP): Selling price, abbreviated SP, is the amount at which we sell an item.

During the purchase and sale of an item, depending upon the CP or SP, it can be either profit or loss for the seller.



Key concepts:

Learning outcomes

- The student will understand profit and loss, components of a simple profit and loss statement, and the importance of a profit and loss statement.
- The student will calculate profits using gross income, total expenses, and cost of goods sold.
- The student will analyze monthly profit and loss statements for a school store and calculate profit margin percentages.

Materials required : Chart papers, colors

Method: Art Integrated Method, Artform used is Role Play

Steps for Instructional Designing

1.Creative skill of the students:

Students were given few groceries and were asked to set up stall in the play ground of the school. They were divided into groups and each group performed a different task in enacting roles like, merchant, vendors, customers, etc. They have sold

different articles. Before selling the articles they have made a note of the cost price of the articles and decided the selling price of the article. They have to finish selling all the products in 2 hours.

2. Presentation and Production of Conceptual understanding:

Students started the activity and got engrossed in it. They have had a lot of discussions between the vendors and customers. They have checked the quality of the products and bargained accordingly.

3. Exploration and Connection:

Students had very limited time so they started attracting customers by giving them discount offers. There were a lot of things happening in the ground which was no less than a market environment. As soon as the time was completed, they started calculating the profit and loss depending on the amount they earned. They have understood the concepts of SP, CP, Profit, Loss, Discount, Percentage.

4. Insights of the learners:

Students were engrossed in the activity and were very attentive in learning and understanding the things. They enjoyed the role played and understood the concept in-depth.

Assessment:

1. Rohit bought a tape-recorder for Rs. 1,500 and sold it for Rs. 1,800. Calculate his profit or loss percent.

2. An old machine is bought for Rs. 1,400 and is sold at a loss of 15%. Find its selling price.

3. A vendor bought lemons at 6 for a rupee and sold them at 4 for a rupee. His gain % is

(a) 50%

(b) 40%

(c) 33%

(d) 16%

4. On selling an article for ₹144 a man loses 10%. At what price should he sell it to gain 10% ?

(a) ₹158.40

(b) ₹172.80

(c) ₹176

(d) ₹192

Class Project: Set up a stall in school premises, prepare food items and sell them within the time given. Calculate Profit/Loss and profit percent/loss percent.



Value Based Learning with Aesthetic sense:

Students have understood the skills needed for selling a product. They have stepped into the shoes of the daily routine people and the difficult task they do. The students visualized the conceptual understanding and this can be done only when a relation is built between the student and community apart from their role and responsibility. This gave them a clear conception of profit and loss and they also understood how to deal with business. The reflections of the students gave contentment to the teachers too. Their plans worked out well and they were quite confident that the students will produce satisfactory performances in the future- whether outside or inside of the school premises.

Role of the teacher

Teacher made the students to understand the concept in a better way with in-depth understanding. This enabled the students to enhance their reasoning and connectivity competency. Students generally lack the rudimental understanding of profit and loss and, therefore, cannot cope up at the higher levels. Thus, the teachers have taken this up as a challenge as profit and loss is not only to obtain grades in the examination but also teach the most needed concept in daily life.

Role of the students

Students need to be attentive in the classroom activities. Learning about different art forms and make the students challenge the world they see around them. They will be able to look at multiple ways in solving problems through their creativity. Students sharpen their intellectual skills and foster higher levels of thinking that carry over to learning other academic subjects.

Objective 4: To study the difference in the attitude towards mathematics through arts integration among the elementary students

Hypothesis 3: There exists no improvement in attitude towards mathematics through arts integration among the elementary students.

Based on the responses obtained from the elementary students on Mathematics attitude scale, the following table shows mean and standard deviation

Table 4.3: Mean and Standard Deviation of Pre-test and Post-test on Attitude of the students.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-attitude	145.5041	242	10.84625	0.69722
	Post-attitude	172.0785	242	21.59880	1.38842

From the above table it clearly shows that the mean of post-attitude scores is more i.e., 172.07 with standard deviation 21.59 when compared to the mean of pre-attitude scores i.e., 145.50 with standard deviation 10.845.

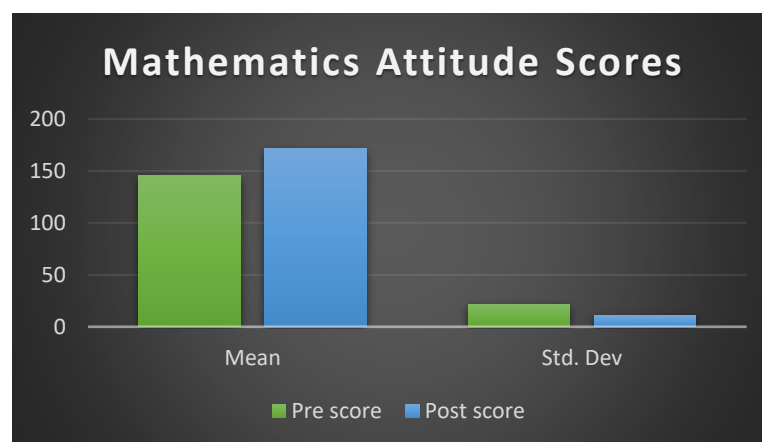


Fig 4.5: Graphical Representation of Mathematics Attitude scores of Elementary Students

Table 4.4: Paired t-test on Attitude scores of the students

		Mean	Std. Deviation	Std. Error Mean	t- value	Df	Sig.
Pair 1	Pre-attitude – post-attitude	26.57438	18.03928	1.15961	22.917	241	.000

Interpretation:

The results of the paired t-test show a significant improvement between pre-attitude scores and post-attitude scores of the students in mathematics with $t = 22.917$, degrees of freedom = 241 at 0.01 level of significance. Students' attitude towards mathematics has been developed positively after the post-test. This means students were able to improve their attitude towards mathematics after integrating arts into mathematical concepts. Thus, Null hypothesis is rejected and Alternate Hypothesis is accepted, which means that there exists an improvement in the attitude of the students in mathematics at elementary level.

Obj 5: To study the effectiveness of mathematical conceptualization through arts integration among the elementary students

Hypothesis 4: There exists no difference in the mathematical conceptualization through arts integration among the elementary students

Table 4.5: Mean and standard deviation of Pre-test and Post-test on Conceptualization scores of the students.

	Mean	N	Std. Deviation	Std. Error Mean
Pretest	16.5579	242	5.57100	.23560
Posttest	25.5764	242	3.66510	.35812

From the above table it clearly shows that the mean of post-test achievement scores is more i.e., 25.5764 with standard deviation 3.66 when compared to the mean of pre-test scores i.e., 16.5579 with standard deviation 5.57.

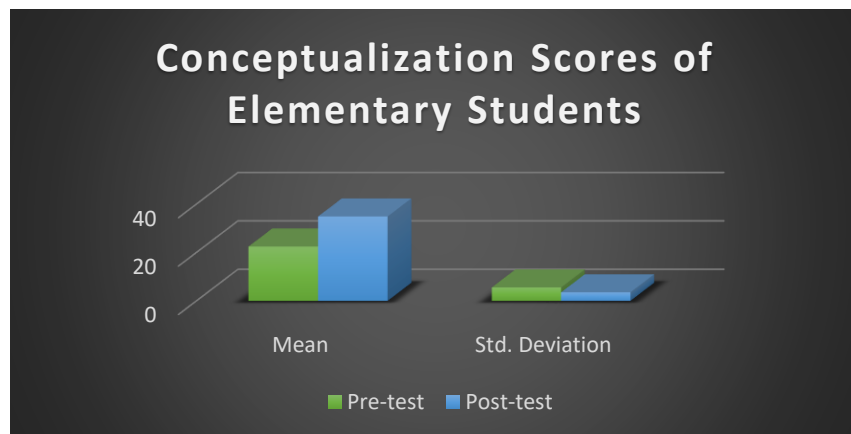


Fig 4.6: Graphical Representation of Mathematical Conceptualization Scores of Elementary Students

Table 4.6: Paired t-test on Conceptualization scores of the students

	Mean	Std. Deviation	Std. Error Mean	t-test	df	Sig.(2- tailed)
Pair 1 pretest posttest	9.01860	3.63059	.23338	38.64	241	.000**

** t-test is significant at 0.01 level

Interpretation:

The results of the paired t-test show a significant difference between pre-test and post-test levels of learners' mathematical conceptualization with respect to arts integration in the mathematics classroom with $t = 38.64$, degrees of freedom = 241 at 0.01 level of significance. Learners involved in the art-integrated mathematics classroom increased their mean scores from 16.5579 to 25.5764. Thus, Null Hypothesis is rejected and Alternate Hypothesis is accepted, which means that there exists a difference in the conceptualization of mathematical concepts of the students at elementary level.

Objective 6: To find the correlation between mathematical conceptualization and positive attitude among the students

Hypothesis 5: There exists no correlation between mathematical conceptualization and positive attitude among the student.

Based on the scores obtained in achievement test and attitude among the elementary students, correlation has been calculated.

Table 4.7: Correlation between Conceptualization scores and Attitude scores

		Conceptualization Scores	Attitude Scores
Conceptualization Scores	Pearson Correlation	1	.918**
	Sig. (2-tailed)		.000
	N	242	242
Attitude Scores	Pearson Correlation	.918**	1
	Sig. (2-tailed)	.000	
	N	242	242

** Correlation is significant at 0.01 level (2-tailed)

Interpretation

The results of the Karl Pearson's Correlation Coefficient shows that the Conceptualization scores of Mathematics are positively correlated with that of the Attitude scores with $r = 0.918$ at 0.01 Level of significance. The relationship between the mathematical conceptualization and the attitude of the students at elementary level indicates that there is highly positive correlation. Therefore, we reject the Null Hypothesis accept the Alternative hypothesis i.e., There exists a correlation between mathematical conceptualization and attitude among the students.

Objective 7: To explore the perceptions of the teachers in adopting art integrated lessons in teaching mathematics

Research Question 2: How the teachers perceive adopting art integrated strategies in mathematical concepts at elementary level?

To know the perceptions of the teachers on the Integration of Arts in Mathematics has been done by a perception scale developed by the researcher.

ITEM WISE GRAPHICAL REPRESENTATION OF DESCRIPTIVE ANALYSIS HAS BEEN GIVEN BELOW

Item 5: Graphical Representation on No. of teachers who incorporated of Arts integration into teaching

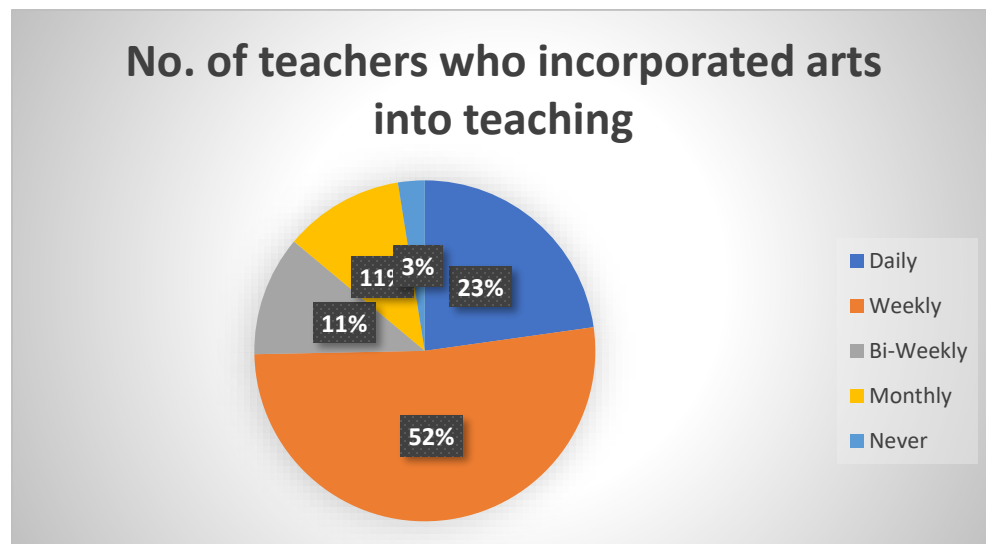


Fig 4.7: Graphical Representation of teachers who incorporated arts into teaching

Interpretation

Of the 80 participants, 23% of the teachers stated that they incorporated the arts into their classrooms daily, 52% stated that they incorporated the arts into their classrooms weekly, 11% stated that they incorporated the arts into their classrooms

biweekly, 11% stated that they incorporated the arts into their classrooms monthly, and 3% stated that they never incorporate the arts into their classrooms.

Item 6. When I am integrating arts into mathematics, I make my students work with any art form and relate to the mathematical concepts

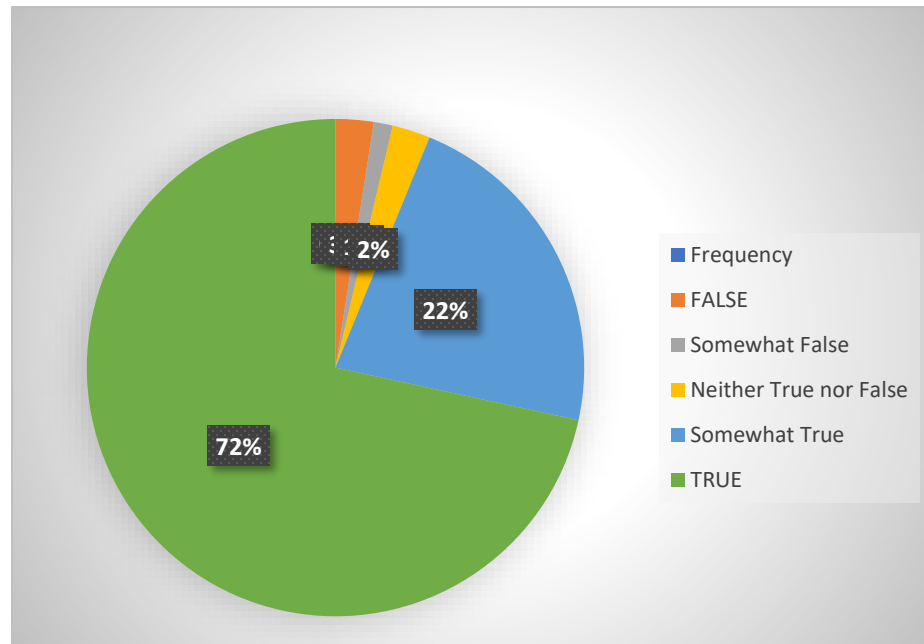


Fig 4.8: Graphical Interpretation of teachers who allowed students to relate mathematics to any art form

Interpretation

The results show that 72% of the teachers opine that integrating arts into mathematics concepts has made the students to relate the problem solving procedure to mathematical concepts being taught which means that application of abstract concepts was made clear by teaching them through arts integration.

Item 7: When I am integrating arts into mathematics, I give my students freedom to choose and create their own art.

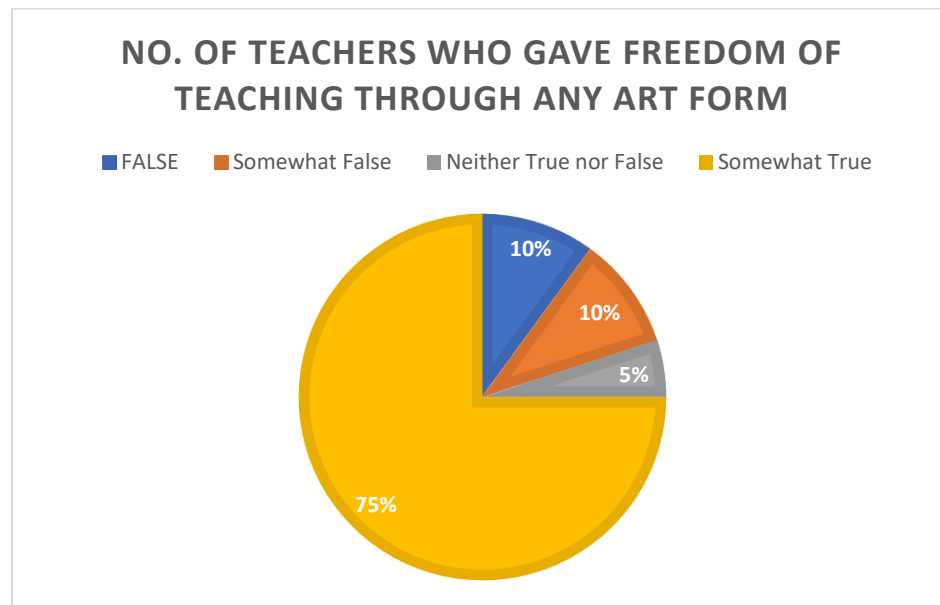


Fig 4.9: Graphical representation: Freedom to choose and create any art form

Interpretation

From the above chart, the results show that 75% of the teachers opine that integrating arts into mathematics gives students freedom to choose their own art. Students have chosen different art forms in learning mathematical concepts which created joyful learning in the classroom

Item 8. I think students can recall information better when the arts are incorporated into mathematics.

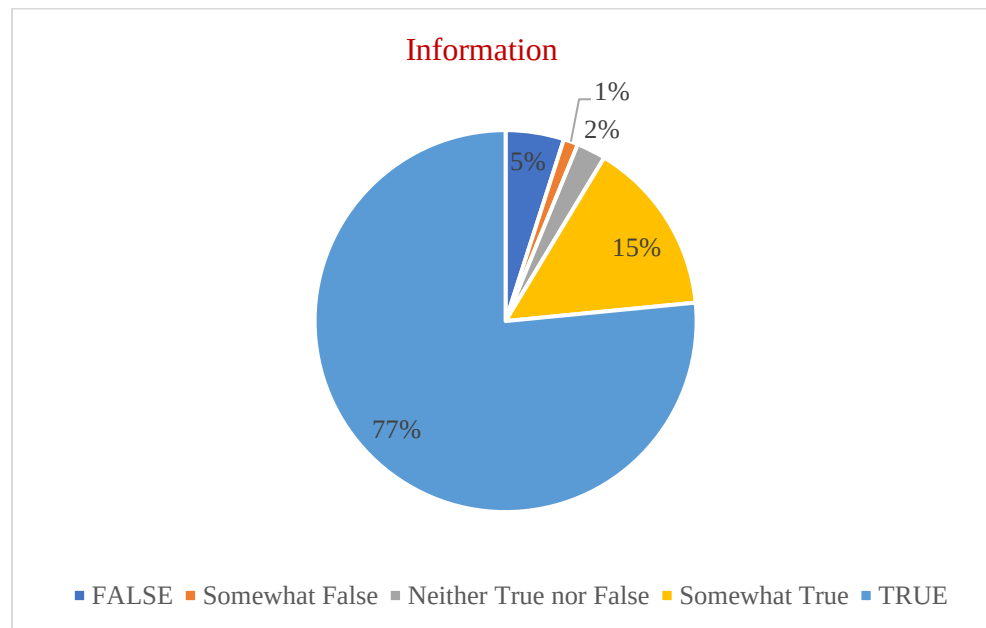


Fig 4.10: Graphical representation of retaining information when arts are integrated

Interpretation

The results show that 77% of the teachers opine that students recall information better when arts are incorporated into mathematics. Students had high memory retention while learning the mathematical concepts through arts integration. Students were able to solve mathematical problems based on the strategy used during the teaching-learning process.

Item 9. I think students enjoy mathematics more when arts are incorporated into the teaching strategies

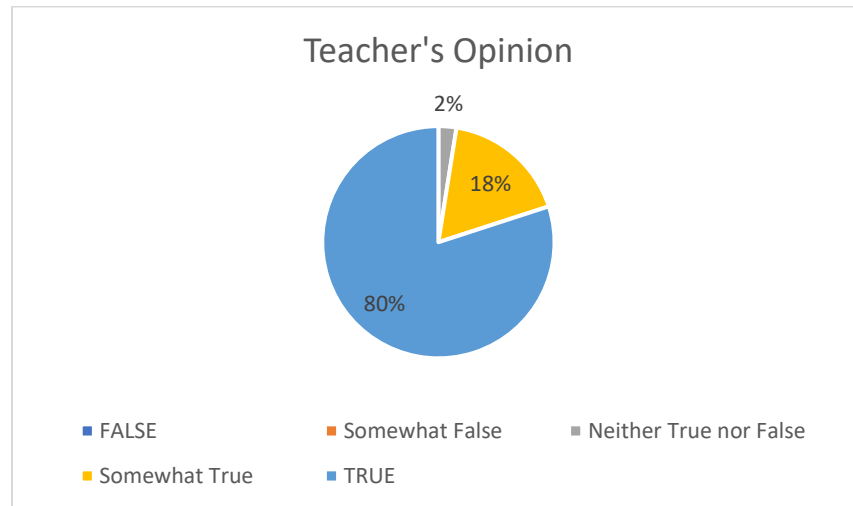


Fig 4.11: Graphical representation of teacher's opinion on enjoying mathematics when arts are incorporated into teaching strategies

Interpretation

The results from the above chart show that 80% of the teachers believe that students enjoyed mathematics classes more when arts are incorporated into teaching strategies. When mathematical concepts were taught by integrating arts, had made the students to actively participate and enjoy the classroom interactions thoroughly.

Item 10. I enjoy mathematics more when arts are incorporated into teaching strategies.

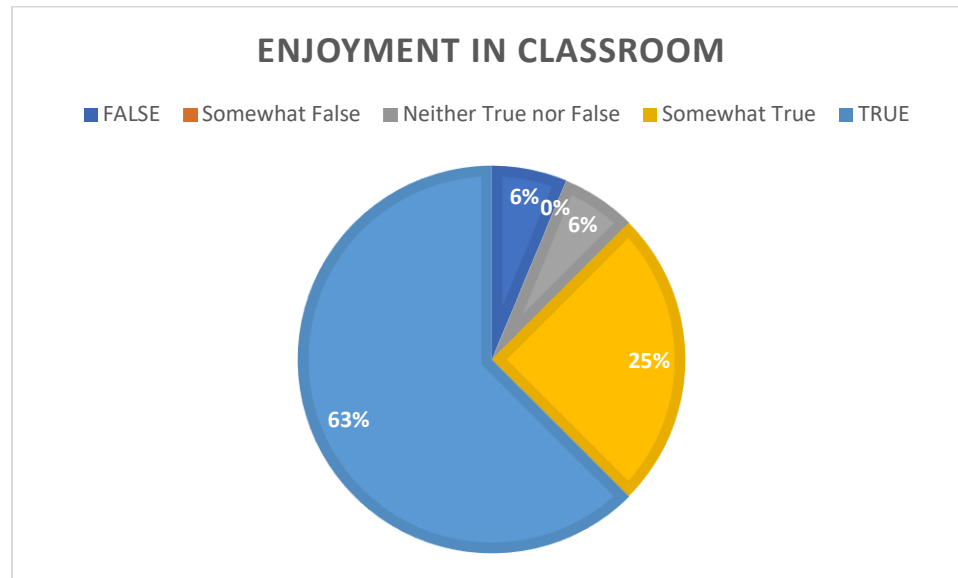


Fig 4.12: Graphical representation on teacher's opinion on enjoyment in classroom

Interpretation

The results from the above chart show that 63% of the teachers enjoyed classroom interactions in mathematics when arts are incorporated into it. 25% of the teachers found that art integrated classes consume a lot of time where they found it difficult in planning the syllabus within the given time period.

Item 11. The arts do not affect my students' conceptual understanding.

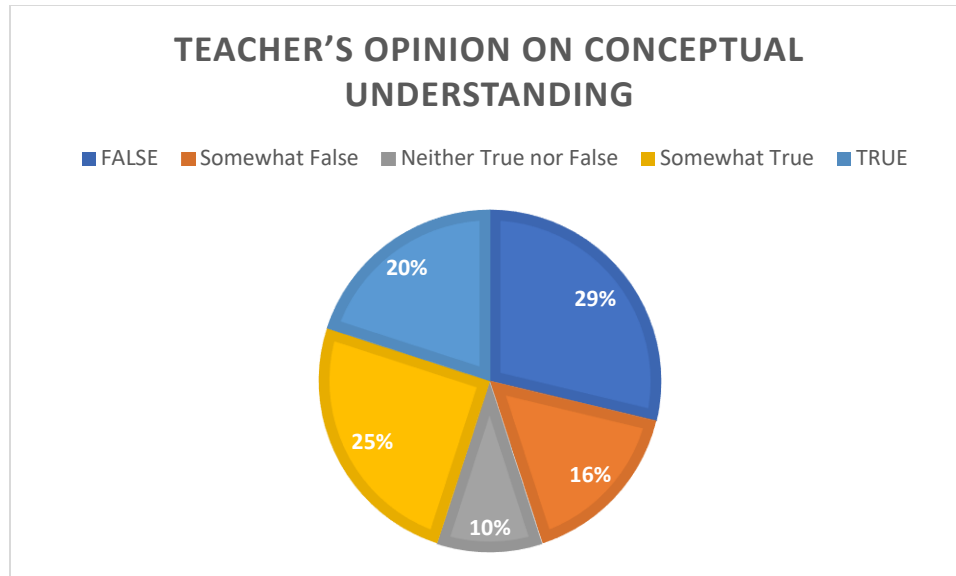


Fig 4.13: Graphical representation on teacher's opinion on conceptual understanding

Interpretation

The results from the above chart show that 29% of the teachers opine that arts does not affect student's conceptual understanding. 20% of the teachers believe that arts affects the student's conceptual understanding by learning the abstract concepts in depth.

Item 12. I do not have time to incorporate the arts in my classroom due to vast syllabus.

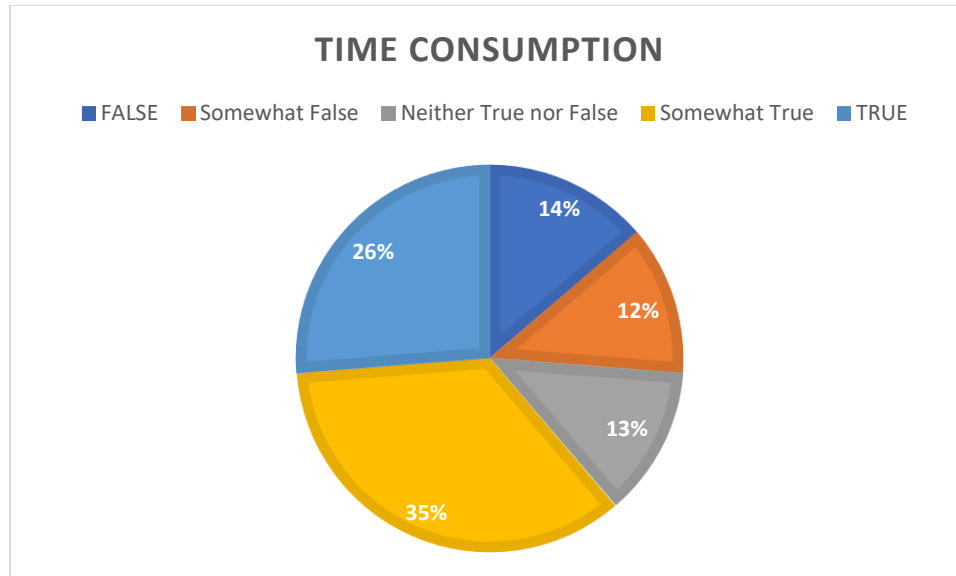


Fig 4.14: Graphical representation on teacher's opinion on time consumption in arts incorporation

Interpretation

The results from the above chart show that 61% of the teachers opine that they don't have to incorporate arts into teaching due to vast syllabus. 26% of the teachers opine that it can managed when planned accordingly depending the concept taught and choosing the appropriate art form.

Item14. I don't have enough space to use movement effectively in the classroom

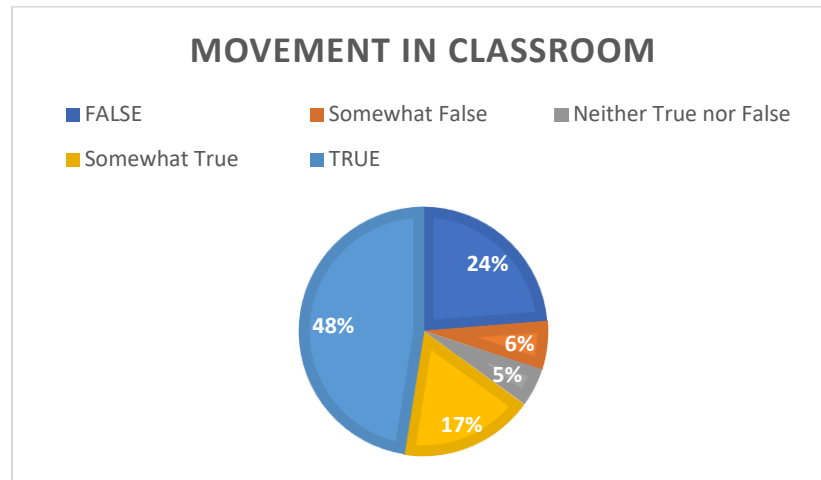


Fig 4.15: Graphical representation on teacher's opinion spatial movement in classroom

Interpretation

The above results show that 48% of the teachers do not have enough space in the classroom to use movement effectively. Teachers mostly use common hall of the school for such teaching strategies but all teachers may not get the opportunities frequently in taking classes.

Item 15. I am free to use new teaching strategies in my classroom to be more effective while teaching.

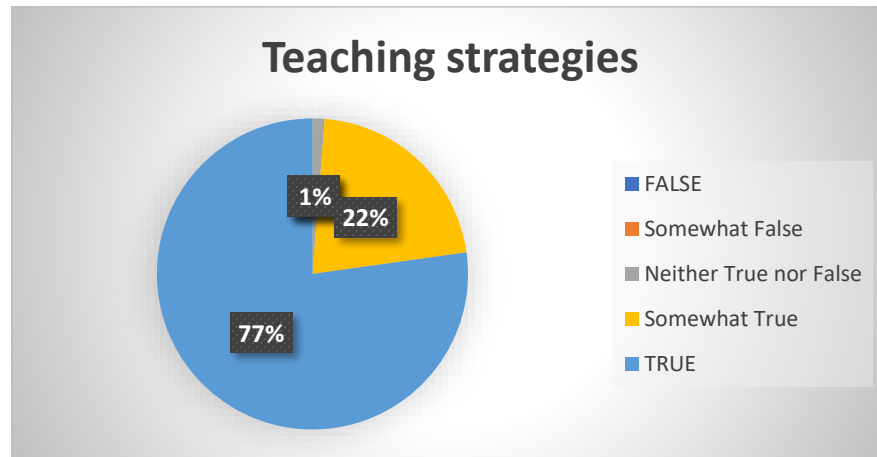


Fig 4.16: Graphical representation on teacher's opinion on new teaching in classroom

Interpretation

The results show that 77% of the teachers opine that they are free to use any new teaching strategies in respected classrooms for effective teaching. This means there is no pressure from the administration on the type of teaching strategies adopted by the teachers in teaching learning process.

Item 16 & 17. I feel confident in my ability to teach visual arts and performing arts in my classroom

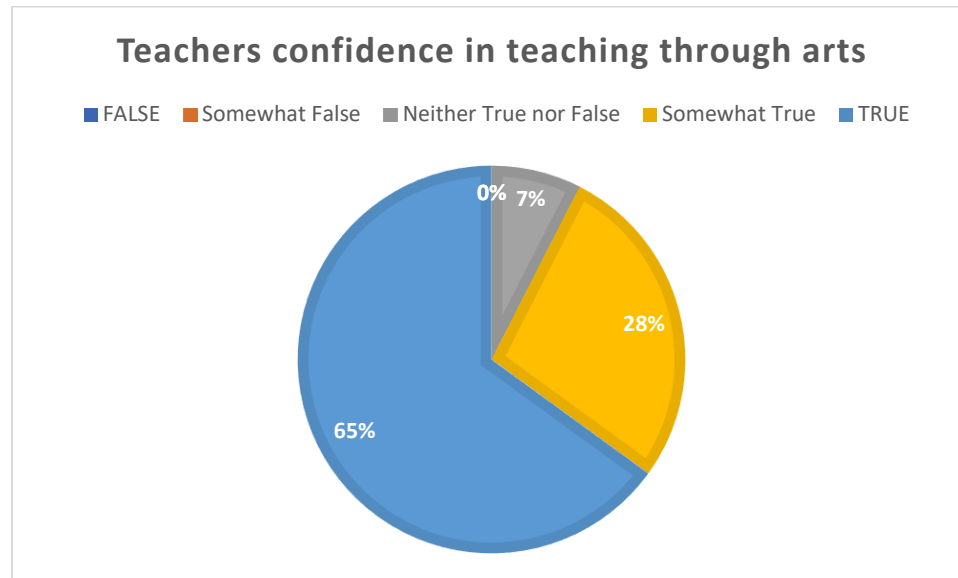


Fig 4.17: Graphical representation on teacher's opinion on confidence in teaching through arts in classroom

Interpretation

The results show, 65% of the teachers felt very confident on their ability to teach visual arts and performing arts in the classroom. The teachers were able to relate mathematical concepts with different artforms depending on the student's understanding and interests.

Item 18. I am a creative person in enhancing joyful learning in my classroom

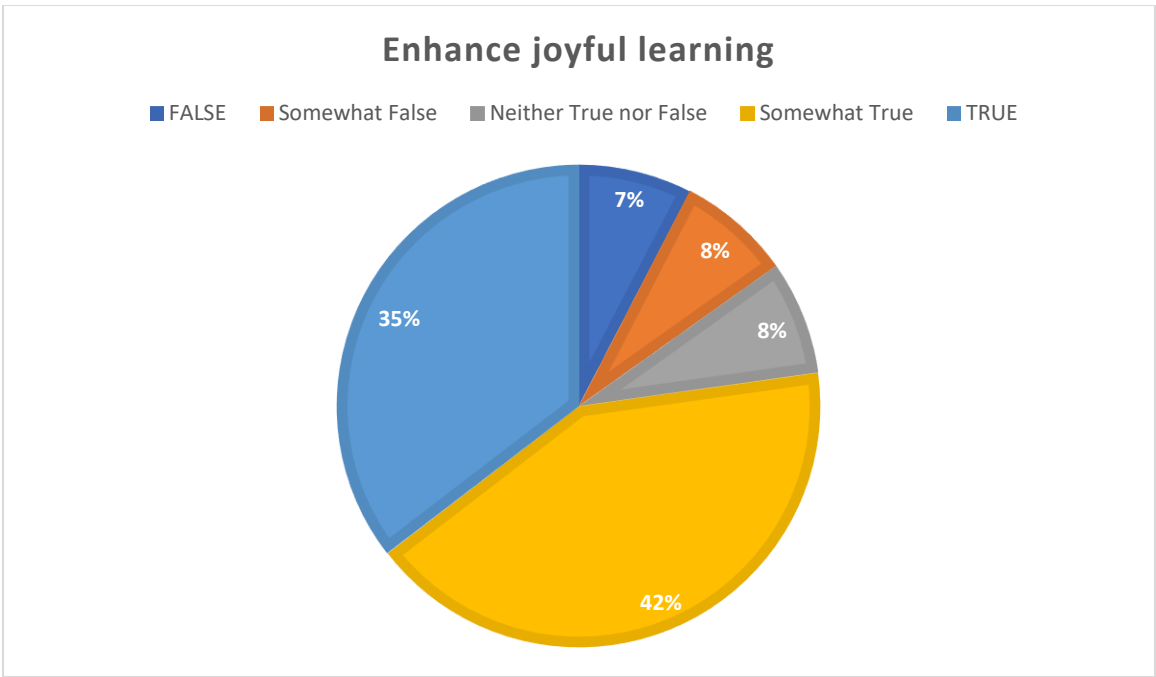


Fig 18: Graphical Representation of teachers opinion on enhancing joyful learning in classroom.

Interpretation

The results show that nearly 77% (35+42) of the teachers opine that they are creative in enhancing joyful learning in classroom. Teachers were very much interested in learning as well as teaching students through arts integration as they were very attentive and all the students attended school every day.

19. Pressure from curriculum standards prevents me from incorporating the arts.

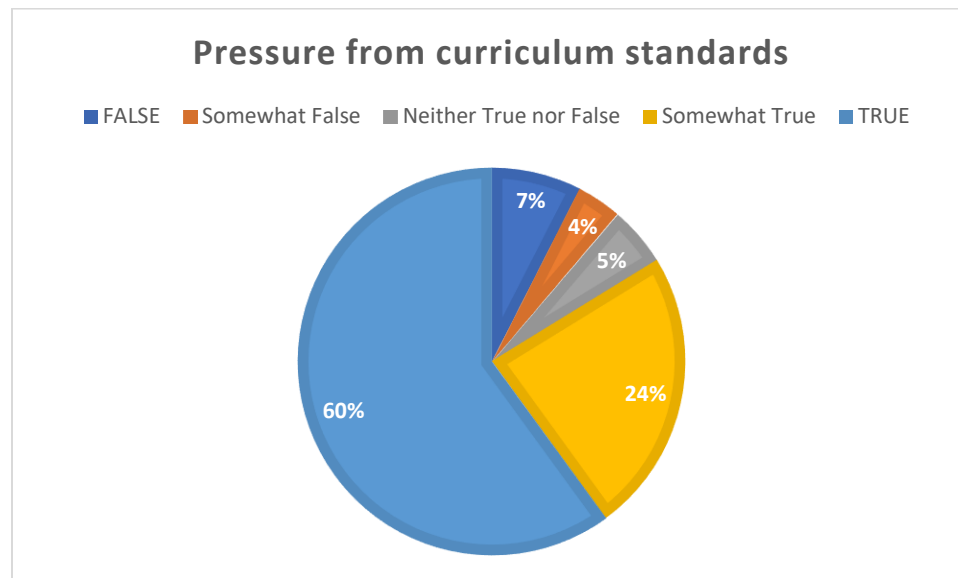


Fig 4.19: Graphical Representation on Pressure from curriculum standards in incorporating arts

Interpretation

The results show that 60% teachers feel the pressure from the curriculum standards which prevents them from incorporating arts into the classroom teaching. As the syllabus is vast, it was very difficult for the teachers to teach through arts integration as it consumes time.

Item 20. In my classroom, Arts forms incorporated are

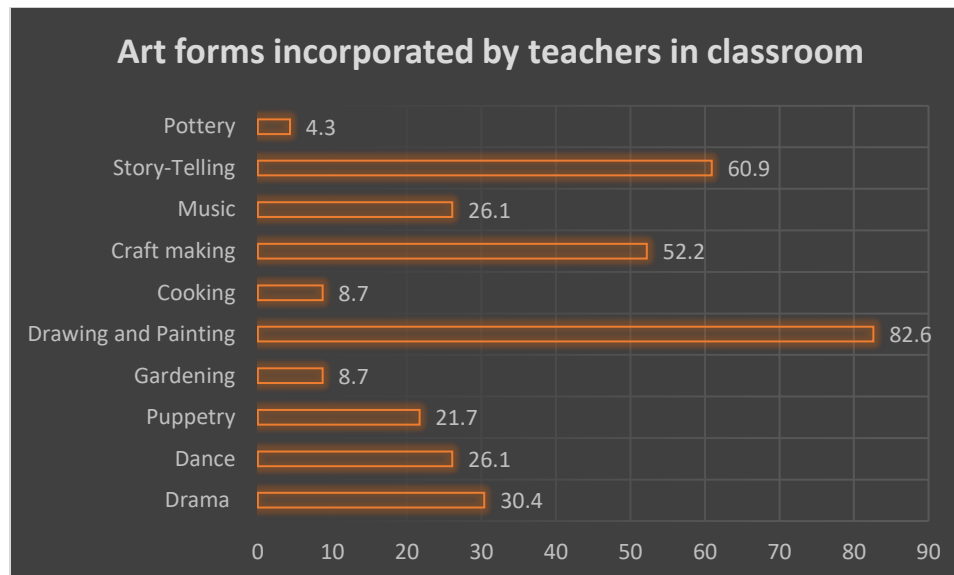


Fig 4.20: Graphical representation of art forms incorporated in classrooms

Interpretation

The above results show that 82.6% of the teachers incorporated drawing and painting into their teaching, 60.9% through story-telling in mathematics classroom. 52.2% through craft making, 30.4% through drama, 26.1% through dance and music, 21.7% through puppetry, 8.7% through cooking and gardening and only 4.3% through pottery.

Item 21. I incorporate arts into Mathematical Concepts such as

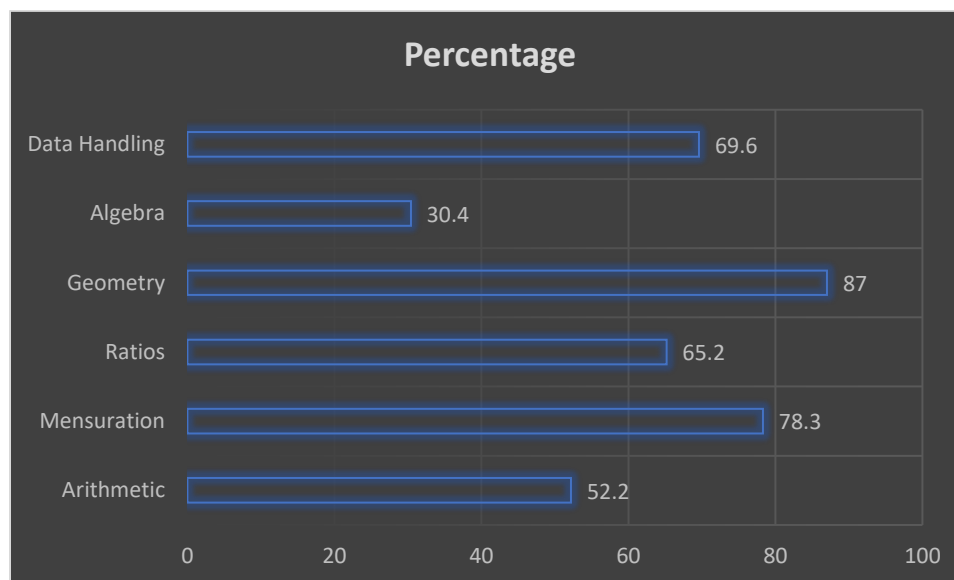


Fig 4.21: Mathematical concepts taught by incorporating different art forms

Interpretation

The results show that 87% of the teachers incorporated arts into Geometry, 78.3% in Mensuration, 69.6% in Data Handling, 65.2% in Ratios, 52.2% in Arithmetic and only 30.4% in Algebra.

25. Do you Art education Supports Academic conceptualization Why? Why not?

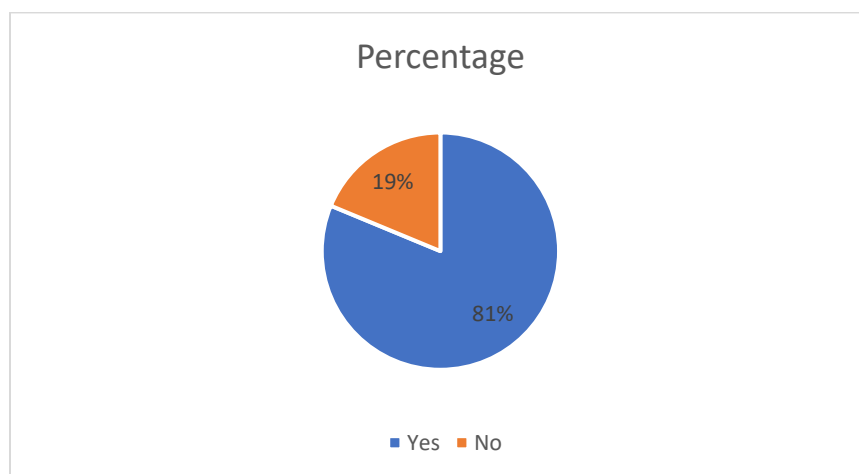


Fig 4.22: Graphical representation on teachers' opinion on academic conceptualization through arts integration

Interpretation:

The results from the above chart show that, 81% of the teachers say that teaching mathematics through arts integration has increased the academic conceptualization of the students. Only 19% of the teachers say the academic conceptualization may not be due to arts integration as they feel it may not be possible to teach the whole syllabus through arts integration.

4.3 THEMATIC ANALYSIS

Table 4.8: Representation of Thematic analysis of responses of teachers

Q. No.	Question	Codes		Categories	Themes
22	In what ways can arts integration benefit students?	Relating content to artforms Understanding concepts in practical way Creating interest among students Made math fun loving Improve creative thinking Not boring Active participation	Independent thinking Self-learning Confidence Intellectual skills Enhanced imagination Critical thinking More socialization Long retention of knowledge	Creating Interest on concept Imagination Building Collaborative Work Active participation Relation building Less Anxiety Excitement Less Memorization Fun Loving Math Long Retention Learning Art forms	Creative thinking Joyful learning Stress reduction Socialization
23	Why do teachers choose or not choose to integrate arts into their instruction?	Gain knowledge Better understanding Remove fear of math Interactive interesting know cultures and traditions	Time consuming More strength in classroom No flexibility in curriculum Teachers opinions Vast syllabus, Team spirit	Attention Interactive Unique ideas Positive Attitude	Indepth conceptual understanding Flexibility in curriculum
24	How do your students react when arts are incorporated into mathematics?	Enjoy Active participation Full Strength in class Eagerness to know more Exploration	Happy Attentiveness Asking questions Multi-Tasking Team work	Full Participation Happy learning Eagerness to know more Exploration	Joyful Learning Collaborative work
26	What do you feel about teachers' role in academic achievement in mathematics?	Skill Based Learning Addressing Individual needs Critical Thinking Continuous Feedback	Observation Collaborative Learning Self-Learning Self-Confidence Self-Sustenance	Skill development Feedback Observation Cognitive Affective	Holistic Development Conceptual Understanding Assessment Self-Reliance

27	Strongest current motivation for to use arts in teaching?	Joyful Learning Interest Development Team Work Concept Visualization Happiness Positive Attitude	Simplifying subject Integrated Curriculum Learning by Doing Simplifying subject	Integrated curriculum Teamwork	Positive Attitude Effective conceptualization Innovative curriculum
28	What would motivate teachers to use arts more than they already do?	Flexible Curriculum deeper understanding no stress vast syllabus build rapport	Better approaches Activity based learning	Curriculum change Participation of parents Easy syllabus completion Teacher student relation	Flexibility in Curriculum Awareness among parents Less Stress on Syllabus completion
29	What professional development programmes have teachers had regarding arts integration?	Not attended Only seminars Workshops Lesson plans Classroom management	Project based learning Teacher training Faculty development programmes	Seminars Workshops Teacher training	NCERT NISHTHA FDP

Item 22. In what ways can arts integration benefit students?

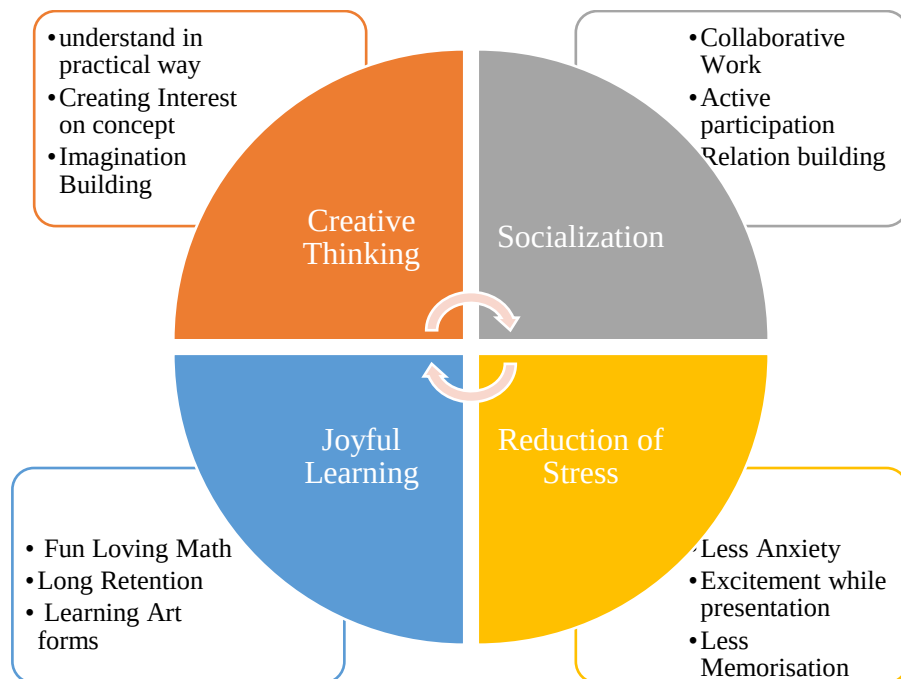


Fig 4.23: Thematic Representation on Benefits of Arts integration to students

Explanation:

The responses given by the teachers were analyzed to know the benefits of the students when arts are incorporated into teaching mathematical concepts. Student's Creative thinking has been enhanced where they were able to understand the concepts in a practical way. Teaching through art forms has created Interest in learning the concept in depth. Students have explored through more imagination which enhanced their thought process in learning by doing on their own and connecting them in practical aspects. Socialization in the classroom has been developed through integrating different art forms into mathematical concepts which made the students to work collaboratively in groups, Students' actively participated in the class and got an understanding on what is taught. Students were able to analyze that the thoughts shared by every student has given inputs to accomplish the task given by the teacher and therefore a strong relation was built among them. Reduction of Stress was very important in this teaching learning process as students felt as they were learning in art class. They were much excited in coming to school and attending mathematics class in learning as well as participating in the activities. This made them less anxious about what is taught and very much excited in knowing the formulae rather than only memorizing them without any knowledge of it. Thus, they were many benefits when arts are incorporated into the abstract concepts in mathematics.

Item 23. Why do teachers choose or not choose to integrate arts into academic instruction

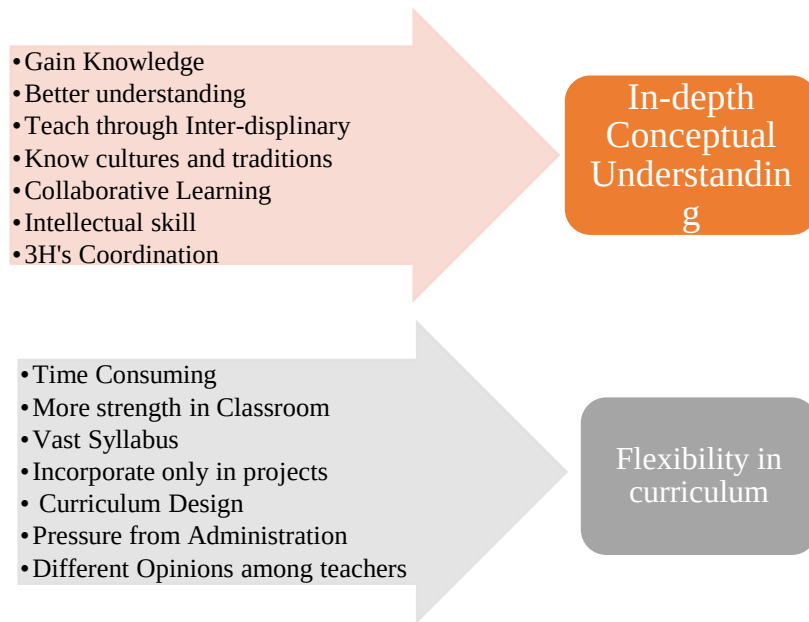


Fig 4.24: Thematic representation of integrating art in academic instruction

Explanation:

The responses given by the teachers show that most of them chose to integrate arts into academic subjects so that students gain more knowledge when concepts are taught through arts. A better understanding can be given to the students in order to make them more knowledgeable on what is taught. Integrating two different curricular aspects like arts and mathematics makes the curriculum inter-disciplinary while teaching and learning. Through arts integration students will be able to learn about the history of the art forms and also the rich culture behind them which enriches their knowledge and interest on developing skills. Collaborative learning promotes active listening and critical thinking, establishes group goals and its value,

students will have better concept retention and develops leadership qualities with self – management skills. Integrating heads-on, hands-on hearts-on learning (the 3Hs) can be an effective way to teach mathematics. Through different art forms, students can guide their own learning and develop a deeper, intrinsically motivated understanding of the concepts. When integrating arts with the 3Hs, teachers continue to provide guided scaffolding and serve as facilitators of scientific knowledge, inquiry, and appreciation.

Some the teachers chose not to teach through arts integration in mathematics classroom because of the strength of class where on an average teacher pupil ratio is 1:45. Teachers also say that the syllabus is vast and only few topics can be taught using artforms. Most of the time, projects are given to the students where they have to present innovatively the concepts. The curriculum is framed in such a way that it takes more time than the allotted period to complete the syllabus. Pressure from the administration also makes them nervous in completing the syllabus as there need to be maintained an equal pace with other schools too. Sometimes teachers have different opinions on how the concept is taught and this may not acceptable by the experienced teachers as they are still following the traditional chalk and board method. Therefore, teachers whether have chosen arts integration or not they need to follow the latest National Policy Education 2020 and implement it very soon.

Item 24. Student's Reaction when arts are incorporated into academic subject

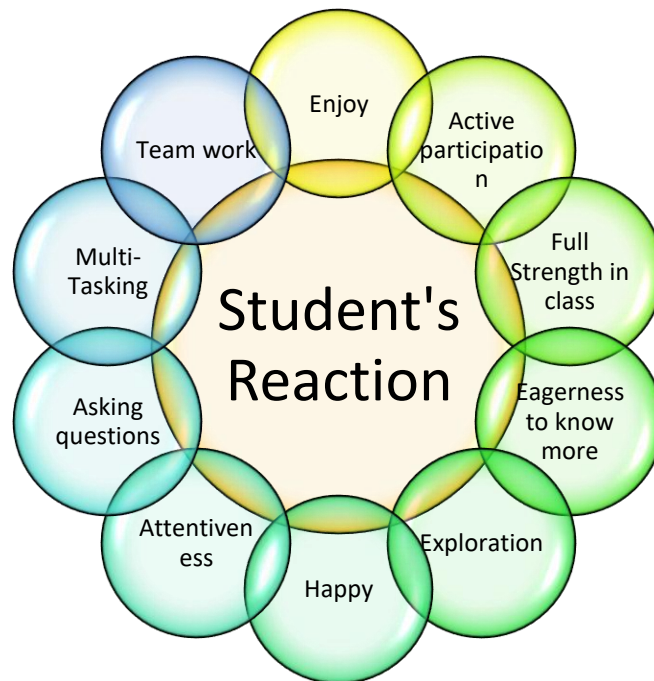


Fig 4.25: Thematic Representation of student's reaction on arts integration

Explanation

When arts are incorporated into mathematics, teacher observed that students reacted positively by enjoy the lessons taught, actively participated in the classroom, they have explored about the concepts with teamwork, were eager to learn the logic and reasoning behind the formulae taught with practical aspects put into practice. Teacher has given multi-tasks to the students so that they can develop more than one skill. Students were excited for attending mathematics classes which increased the daily attendance of the students.

Item 26. What do you feel your role is in supporting academic conceptualization in your classroom?

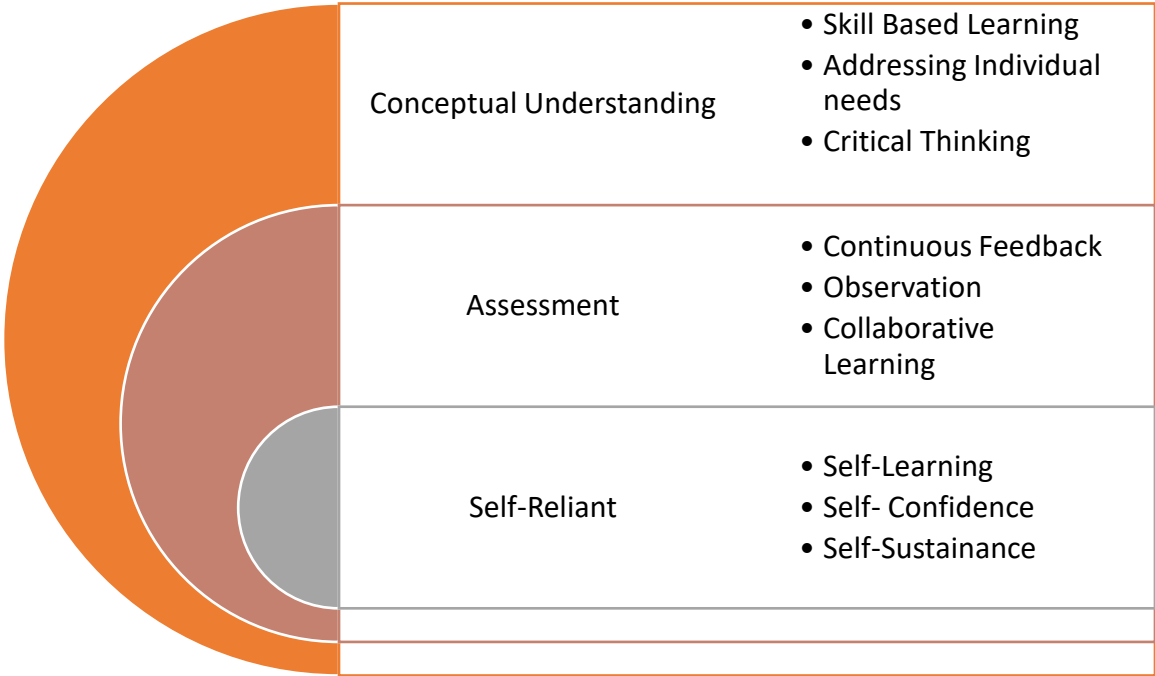


Fig 4.26: Thematic representation of Role in arts integration in supporting academic achievement

Explanation:

Role of the teacher is very important in supporting the academic conceptualization of the students as whatever is taught by the teacher mostly reflects on the scores obtained by the students during assessment. Integrating arts in mathematics concepts has made the teachers believe that it highly supports the academic conceptualization of the students by increasing conceptual understanding of students through skill-based learning, addressing every individual’s needs and making them critical thinkers to know the reason behind learning a particular concept. Assessment of the students was done smoothly without anxiety by students

as they were observed continuously and feedback was given to them at every stage. Students were able to learn collaboratively as every student supported by valuing each other's opinion. They were self-reliant in arriving at conclusion and making judgements. Students were confident in explaining what has been taught and understood the concepts clearly. When sharing thoughts of the individuals in the group they were self-sustained on contribution of ideas from their peers. Therefore, through arts integration teachers best supported in the high academic conceptualization of the students.

Item 27. Strong Current motivation for teachers to use arts in your teaching



Fig 4.27: Thematic representation of Student's motivation

Explanation:

Integration of arts in teaching mathematics motivated the students to learn more from their teachers by probing varied answers in the classroom teaching learning

process. This motivation led to making the concepts simple and understandable to the teachers, developed interest among them in exploring more, and made them work in teams. This encouraged every student's contribution towards concept attainment. Students developed a positive attitude on the subject, making them learn without fear and anxiety. Thus, integrating arts into mathematical concepts has positively motivated the teachers to incorporate integrated curriculum in their respective classrooms.

Item 28. What would motivate teachers to use arts more than you already do?

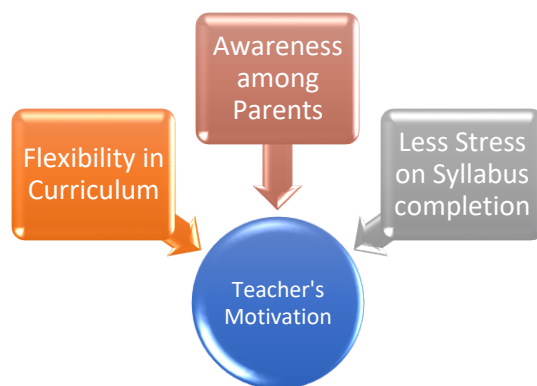


Fig 4.28: Thematic representation of Teacher's motivation

Explanation:

Teachers opine that arts integration can be done in the mathematics subject depending on the curriculum being framed. According to the teachers the syllabus is very vast and the time constraint is very less. Teaching through arts enhances the intellectual and conceptual understanding among the students but may not be possible throughout the academics. If awareness and interest is created among parents so that few artforms in education such as culinary arts, gardening, etc., can

be learnt at home with its incorporation into mathematics concepts. Teachers usually have high stress levels of completing the portion as students always find difficult in remembering lessons previously taught. It takes time to make the students learn new concepts every time. If the concepts in mathematics are interconnected, it will be easy for the teachers to use the spiral approach in teaching. Thus, teacher's need external motivation from the administration, parents and students to incorporate innovative strategies in the teaching learning process.

Item 29. What professional development programmes did in-service teachers attended regarding arts integration?

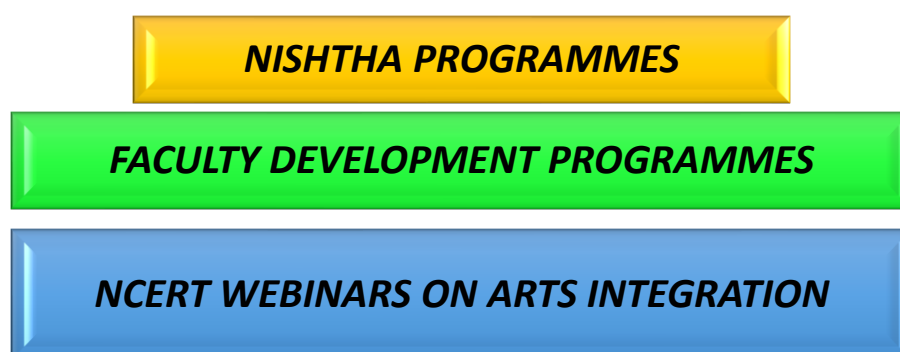


Fig 4.29: Thematic Representation of Professional Development programmes

Explanation:

Teachers from CBSE schools had in-service programmes every year conducted by NCERT and NISHTHA. Many teacher education institutions have conducted integrated training webinars and workshops. Faculty development programmes were conducted both online and offline mode. Researcher has conducted intervention programme for the teachers which made the teachers to enhance

creative ideas on how different art forms can be integrated into mathematical concepts.

CHAPTER 5

FINDINGS AND DISCUSSION

5.0 Introduction

In the preceding chapter data collection has been analysed, represented and interpreted the results. The first section contributes to an overall summary of the study followed by the major findings and their discussions. Subsequent to this are the educational implications of the study and followed by recommendations and suggestions further research

5.1 Summary

This research study has provided information on arts integration in the mathematics classroom that has reaffirmed prior research and has provided extensions of knowledge, examples of best practices, and tips for teachers to incorporate the different art forms in their mathematical concepts. This study aims to develop positive attitude in mathematics among the elementary students and build effective mathematical conceptualization to understand abstract concepts in detail with practical knowledge. The present study is organized into five chapters. The outline of the research is presented in the first chapter while the second chapter reviews the literature related various studies on arts integration across the globe, literature related to attitude of students towards mathematics and also related literature on perceptions of teachers in arts integration. The research methodology and data collection methods are discussed in the third chapter. Fourth chapter provides an in-depth quantitative and qualitative data analysis.

The present chapter will present findings and discussions of the study, educational implications, recommendations of the study and suggestions for further research.

5.2 Major Findings

Based on the data collection and analysis, the overall findings of the study are given below

- The pre-attitude scores of the students reveal that 72% of the elementary students have low attitude in mathematics, 15% of them possess moderate attitude and only 4% of the elementary students possess high attitude in Mathematics. The reason for this could be the fear among the students regarding the understanding of mathematics concepts. Thus, Alternate Hypothesis is rejected that is most of the students have a moderate attitude towards mathematics.
- The achievement scores of the students obtained from the achievement test reveal that 57% of the elementary students have low conceptualization in mathematics. Only 23% of the students have moderate mathematics conceptualization. Therefore, Alternate hypothesis is accepted that is most of elementary students lack conceptualization in mathematics.
- The results of the paired t-test show a significant difference between pre-test and post-test scores of students' mathematical conceptualization with respect to arts integration in the mathematics classroom with $t = 38.643$, degrees of freedom = 241 at 0.01 level of significance. Students involved in the art-integrated mathematics classroom increased their mean scores from 16.5579 to 25.5764. Thus, Null Hypothesis is rejected and Alternate

Hypothesis is accepted, which means that there exists a significant difference in the mathematical conceptualization of the students at elementary level.

- The results of the paired t-test show a significant change between pre-attitude scores and post-attitude scores of the students in mathematics with $t = 22.917$, degrees of freedom = 241 at 0.01 level of significance. Students' attitude towards mathematics was developed positively after the post-test. This means students were able to improve their attitude towards mathematics after integrating art into mathematical concepts. Thus, Null hypothesis is rejected and Alternate Hypothesis is accepted, which means that there exists a significant improvement in the attitude of the students in mathematics at elementary level.
- The results of the Karl Pearson's Correlation coefficient shows that the conceptualization scores of Mathematics are positively correlated with that of the Attitude scores with $r = 0.918$ at 0.01 level of significance. The relationship between the mathematical conceptualization and the attitude of the students at elementary level indicates that there is highly positive correlation. Therefore, we reject the Null Hypothesis accept the Alternative hypothesis i.e., There exists a significant correlation between mathematical conceptualization and attitude among the students at elementary level.
- Out of the 80 teachers who participated in the study, 23% stated that they incorporated arts into their classrooms daily, 52% weekly, 11% biweekly,

11% monthly and only 3% stated that they never incorporated arts into their mathematics classrooms.

- The mode score (most common score) for item 6 in teacher perception scale was five, meaning that the teachers mostly make students work with any art form and relate them to the mathematical concepts. However, in item12, the mode score was also four, meaning that the teachers stated that they mostly do not have time to incorporate arts in classroom due to vast syllabus. The item with the highest standard deviation was item 14. This indicates that the teachers' opinions vary the most for this question. For item19 the mode was 5, the average was 4.24 and the standard deviation was 1.20, indicating that there was a wide range of answers. This indicates that many teachers have curriculum constraints, which prevents from incorporating arts into curriculum.
- The results show that 72% of the teachers opine that integrating arts into mathematics has made the students to relate them to mathematical concepts which means that application of abstract concepts was made clear through arts integration.
- The results show that 75% of the teachers opine that integrating arts into mathematics gave students freedom to choose their own art. Students have chosen different art forms in learning mathematical concepts which created joyful learning in the classroom.
- The results show that 77% of the teachers opine that students recall information better when arts are incorporated into mathematics. Students

were able to solve mathematical problems based on the strategy used during the teaching learning process.

- The results show that 80% of the teachers believe students enjoyed mathematics classes more when arts are incorporated into teaching strategies. When mathematical concepts were taught by integrating arts had made the students to actively participate and enjoy the classroom interactions thoroughly.
- The results show that 63% of the teachers enjoyed classroom interactions in mathematics when arts are incorporated into it. 25% of the teachers found that art integrated classes consume a lot of time where they found it difficult in planning the syllabus with time given.
- The results show that 29% of the teachers opine that arts does not affect student's conceptual understanding. 20% of the teachers believe that arts affects the student's conceptual understanding by learning the abstract concepts in depth.
- The results show that 61% of the teachers opine that they don't have to incorporate arts into teaching due to vast syllabus. 26% of the teachers opine that it can be managed when planned accordingly depending the concept taught and choosing the appropriate art form.
- The results show that 48% of the teachers do not have enough space in the classroom to use movement effectively in classroom. Teachers mostly use common hall of the school for such teaching strategies but all teachers may not get the opportunities frequently in taking classes.

- The results show that 77% of the teachers opine that they are free to use any new teaching strategies in respected classrooms for effective teaching. This means there is no pressure from the administration on the type of teaching strategies adopted by the teachers in teaching learning process
- The results show, 65% of the teachers felt very confident on their ability to teach visual arts and performing arts in the classroom. The teachers were able to relate mathematical concepts with different artforms depending on the student's understanding and interests.
- The results show that nearly 77% of the teachers opine that they are creative in enhancing joyful learning in classroom. Teachers were very much interested in learning as well as teaching students through arts integration as they were very attentive and all the students attended school everyday.
- The results show that the teachers feel the pressure from the curriculum standards prevent them from incorporating arts into the classroom teaching. As the syllabus is vast it was very difficult for the teachers to teach through arts integration as it consumes time.
- The results show that 82.6% of the teachers incorporated drawing and painting into their teaching. 60.9% taught through story-telling in mathematics classroom. 52.2% taught through Craft making, 30.4% taught through drama, 26.1% taught through dance and music, 21.7% through puppetry, 8.7% through cooking and gardening and only 4.3% through pottery.

- The results show that 87% of the teachers incorporated arts into Geometry, 78.3% in Mensuration, 69.6% in Data Handling, 65.2% in Ratios, 52.2% in Arithmetic and only 30.4% in Algebra.

Qualitative Analysis

The responses given by the teachers were analyzed to know the benefits of the students when arts are incorporated into teaching mathematical concepts.

- Student's Creative thinking has been enhanced where they were able to understand the concepts in a practical way. Teaching through art forms has created interest in learning the concept in depth. Students have explored through more imagination which enhanced their thought process in learning by doing on their own and connecting them in practical aspects.
- Socialization in the classroom has been developed through integrating different art forms into mathematical concepts which made the students to work collaboratively in groups. Students actively participated in the class and got an understanding on what is taught. Students were able to analyze that the thoughts shared by every student has given inputs to accomplish the task given by the teacher and therefore a strong relation was built among them.
- Reduction of Stress was very important aspect in this teaching learning process as student felt they were learning in an art class. They were much excited in coming to school and attending mathematics class in learning as well as participating in the activities. This made them to be less anxious in

what is taught and very much excited in knowing the formulae rather than only memorizing them without any knowledge of it. Thus, they were many benefits when arts are incorporated into the abstract concepts in mathematics.

- The responses given by the teachers show that most of the teachers chose to integrate arts into academic subjects so that students gained more knowledge when concepts are taught through arts. A better understanding was given to the students in order to make them more knowledgeable on what is taught. Integrating two different curricular aspects like arts and mathematics makes the curriculum inter-disciplinary in the process of teaching and learning. Through arts integration students were able to learn about the history of the art forms and also the rich culture behind them which enriched their knowledge and interest on developing skills. Collaborative learning promoted active listening and critical thinking, established group goals and its value, students had better concept retention and developed leadership qualities with self-management skills. Integrating heads-on, hands-on, hearts-on learning (the 3Hs) was an effective way to teach mathematics. Through different art forms, students guided their own learning and developed a deeper, intrinsically motivated understanding of the concepts. When integrating arts with the 3Hs, teachers continued to provide guided scaffolding and served as facilitators of scientific knowledge, inquiry and appreciation.

- Very few teachers chose not to teach through arts integration in mathematics classroom because the strength of the class was more i.e., more than 50 children in each class. Teachers also said that the syllabus is vast and only few topics are taught using artforms. Most of the time, projects are given to the students where they have to present innovatively the concepts. The curriculum is framed in such a way that it takes more time than the allotted period to complete the syllabus. Pressure from the administration also made them nervous in completing the syllabus as there is a need to maintain an equal pace with other schools too. Sometimes teachers have different opinions on how the concept is taught and this may not be acceptable by the experienced teachers as they are still following the traditional chalk and board method. Therefore, teachers whether have chosen arts integration or not they need to follow the latest National Policy Education 2020 and implement it very soon.
- When arts are incorporated into mathematics, teacher observed that students reacted positively by enjoying the lessons taught, actively participated in the classroom, they have explored about the concepts with teamwork, were eager to learn the logic and reasoning behind the formulae taught with practical aspects put into practice. Teacher has given multi-tasks to the students so that they can develop more than one skill. Students were excited for attending mathematics classes which increased the daily attendance of the students. Role of a teacher is very important in supporting the academic conceptualization of the students as whatever is taught by the teacher mostly

reflects on the scores obtained by the students during assessment. Integrating arts in mathematics concepts has made the teachers believe that it highly supports the academic conceptualization of the students by increasing conceptual understanding of students through skill-based learning, addressing every individual's needs and making them critical thinkers to know the reason behind learning a particular concept. Assessment of the students was done smoothly without anxiety as they were observed continuously and feedback was given to them at every stage. Students were able to learn collaboratively as every student supported by valuing each other's opinion. They were self-reliant in arriving at conclusion and making judgements. Students were confident in explaining what has been taught and understood the concepts clearly. When sharing thoughts of the individuals in the group they were self-sustained on contribution of ideas from their peers. Therefore, through arts integration teachers best supported in the high mathematical conceptualization of the students.

5.3 Discussion

Objective 1: To know the attitude of elementary students towards mathematics

The objective is investigated by conducting quantitative analysis. This involved review of the related literature, the major concern of attitude towards mathematics was declining due to fear of solving problems in mathematics which was a difficult task for the students (Eugene, 2019; Tanveer and Rizwan, 2015; Mata 2012). Standardized tool-Modified Fennema Sherman's Mathematics attitude scale has

been adopted for this objective. The students' responses have been collected prior to know the attitude of the students towards mathematics. It has been found that most of the students have negative attitude towards mathematics as they are learning the concepts without any practical understanding. Students lack problem-solving skills when numbers are changed for the same concept. Based on the response obtained from the students it has been found that 72% of the elementary students have low attitude in mathematics, 15% of them possessed moderate attitude and only 4% of the elementary students possessed high attitude in Mathematics. The main reason is the fear among the students regarding the understanding of mathematics concepts. The students lack self-confidence in learning, understanding, and producing them during assessment (Lara 2017). The students did not enjoy how concepts are introduced to them in the classroom without its practical application and relevance in the real world. Students lack motivation from teachers, parents and peers, and therefore, express inability to solve difficult math problems.

Objective 2: To understand the conceptualization of elementary students in mathematics

The objective has been investigated by conducting quantitative analysis. According to the related literatures (Rukavina et.al. 2012; Mohamed, 2011, Capiora 2015, Senthamarai 2016), most of the student's problem-solving skills can be developed only when the students have the ability to solve the known concepts. It is universally accepted that Mathematics is an abstract subject. The task of a teacher is to help his/her students conceptualize the abstractness through concrete

experiences. There is a need to provide ample opportunities to students to concretize various concept or else they may condemn the subject as boring and difficult. Students have less conceptual understanding as they only memorize and apply the formulae. There is a need to build conceptual understanding with its application in real life situations. Based on the Achievement test conducted by the researcher it has been found that 57% of the elementary students have low conceptualization in mathematics. Only 23% of the students have moderate mathematics conceptualization as many students lack connections of the concepts and get confused when dealing with similar ones. Students tend to forget the concepts being taught in the previous stages and there is inability to understand the need and relevance of mathematics in the real world.

Objective 3: To develop art integrated learning module for mathematics teachers at elementary level

The goal of creating an integrated learning module for mathematics was accomplished through a well-contributed procedure. To build and develop the module, the researcher used a theoretical approach and techniques from numerous successful studies (Chantarasombat 2020; NCERT 2019; Randolph 2016; Lara 2017; Criswell 2017). It was constantly reviewed and checked during the module development process, producing an effective learning module. Experiential Learning model given by David Kolb and Art Integrated Model was used in the development process of the Learning Module. Students were inspired by the art integrated learning module because they actively engaged in the activities and learned new things through first-hand encounters with things in their familiar

surroundings. Good behaviour was created through awareness and relatable environments without overly complex activities. Being familiar with something encourages learning interest, greater cooperation, increased learning competency, and the students' ability. This teaching tool has assisted the researcher in developing mathematical conceptualization, brought about an adjustment in the elementary students' attitudes, and made the learning relevant.

Objective 4: To study the difference in the attitude towards mathematics through arts integration among the elementary students

Based on the reviews done to investigate this objective the researcher has used Mathematics attitude scale so that difference in the responses of the students before the pre-test and after post-test has been analysed (Chen and Bae 2018, Whyte 2019, Sparrow 2010, Curtis 2006). The researcher has used the same tool twice. Paired t-test has been used as a statistical technique to study the difference in the pre-test and post-test scores obtained from the responses given. The paired t-test shows a significant difference between pre- attitude and post-attitude scores of the students in mathematics with $t = 22.917$, degrees of freedom = 241 at 0.01 level of significance. Students' attitude towards mathematics has been developed positively after the post-test. This means students have improved their attitude towards mathematics after integrating arts into mathematical concepts. Hence positive attitudinal changes in mathematics are developed among the students, making them easily learn the difficult mathematical concepts without fear and anxiety.

Objective 5: To study the effectiveness of mathematical conceptualization through arts integration among the elementary students

The objective has been investigated by using Achievement test on the elementary students in both pre-test and post-test. Students were given pre-achievement test before the intervention has been conducted. After the intervention programme for three to five weeks in each school based on the topic being dealt, post-achievement test was conducted immediately after the intervention programme. Students have scored much better in the post-test when compared to the pre-test scores. The statistical technique applied for this objective is the paired t-test. The results of the paired t-test show a significant difference between the pre-test and post-test levels of students' mathematical conceptualization with respect to arts integration in the mathematics classroom with $t = 38.643$, degrees of freedom = 241 at 0.01 level of significance. Students involved in the arts-integrated mathematics classroom increased their mean scores from 16.5579 to 25.5764. This proved that students have conceptually understood mathematics more easily through arts integration than the traditional teaching methods (Lauren et.al. 2018, George 2013, Mohammed 2011, Ingram 2003, Gullat 2007). Students have gained application-based knowledge in parallel to the in-depth understanding of the difficult mathematics concepts such as Exponents, Algebra, Data Handling, Ratios and proportions and Percentages. Integration of arts in teaching mathematics motivated the students to learn more from their teachers by probing varied answers in the classroom teaching-learning process. This motivation led to making the concepts simple and understandable to the students, developed interest among them in exploring more, made them work in teams, and encouraged every student's contribution towards concept formation.

Objective 6: To find the relationship between mathematical conceptualization and attitude through arts integration among the elementary students.

The researcher investigated the objective using Karl Pearson Correlation Coefficient to find the relationship between the mathematical conceptualization and attitude of the students at elementary level (Gardners 2016, Randolph 2016, Khan and Ali 2016, McClendon 2018, Long 2014, Puri and Arora 2013). The Karl Pearson's Correlation results showed that the conceptualization scores of Mathematics are positively correlated with that of the Attitude scores with $r = 0.918$ at 0.01 level of significance. The relationship between the mathematical conceptualization and the students' attitude at elementary level indicates a highly positive correlation. The students who have improved conceptual understanding with problem-solving skills were interested in learning the concepts in depth with practical understanding, this made the students to develop positive attitude in mathematics learning. Students were attentive as they were able to apply the mathematical concepts to the application of them in real life situations happening around them.

Objective 7: To explore the perceptions of the teachers in adopting art integrated strategies in teaching mathematics at elementary level.

The researcher has investigated the objective using both quantitative and qualitative methods. In quantitative method descriptive analysis such as mean, mode and percentages have been used whereas in qualitative method thematic analysis has been used. (Badger 2019, Lauren et.al. 2018, Pines 2018, Lobpries 2016, Wright 2016). In quantitative method, Mean was calculated to find the average of the

responses given by the teachers in incorporating art-integrated strategies into the mathematical concepts. Mode was calculated to know frequency of the responses given by the teachers for each item. Standard deviation was calculated to know how each response has deviated from the mean. On the whole teachers felt incorporating different art forms into mathematical concepts was not a difficult task but implementing them in the classroom was difficult. It was very time consuming and students' expectations have increased and wished to learn through arts integration only. Incorporating different arts forms other than drawing and painting was difficult for the teachers in varied mathematical concepts. After the intervention programme teachers have shown more interest in art integrated strategies even though they had many constraints in the curriculum.

In qualitative method Thematic Analysis has been adopted under the same objective to analyze the opinions of the teachers on integrating art into the mathematical concepts. (Fereday et.al. 2016; Lawless et.al. 2012, Thomas 2006). The responses given by the teachers were analyzed to know the benefits of the students when arts are incorporated into teaching mathematical concepts. Student's Creative thinking was enhanced where they were able to understand the concepts in a practical way. Teaching through art forms has created interest in learning the concept in depth. Socialization in the classroom has been developed through integrating different art forms into mathematical concepts which made the students to work collaboratively in groups, students actively participated in the class and got an understanding on what is taught. Reduction of Stress was very important aspect in this teaching-learning process as student felt as they were learning in art class. They were much

excited in coming to school and attending mathematics class in learning as well as participating in the activities. They were many benefits when arts were incorporated into the abstract concepts in mathematics. Teaching through arts enhances the intellectual and conceptual understanding among the students but may not be possible throughout academics. If awareness and interest are created among parents so that few art forms in education, such as culinary arts, gardening, etc., can be learnt at home with its incorporation into mathematics concepts. Teachers usually have high-stress levels of completing the portion as students always find it difficult to remember lessons taught previously. It takes time to make the students learn new concepts every time. If the concepts in mathematics are interconnected, it will be easy for the teachers to use a spiral approach. Thus, teachers need external motivation from the administration, parents and students to incorporate innovative strategies in the teaching-learning process.

5.4 Educational Implications

Making learning fascinating and engaging for students is the main objective of combining mathematics and the arts. In secondary school, math is mainly used to teach fundamental ideas that are used by everyone on a daily basis. In later courses, when the material becomes more abstract and symbolic, students will be better prepared to put in more effort if they have early exposure to the beauty, playfulness, challenge, and utility of mathematics. Students will also be more likely to choose jobs in subjects like computer science, architecture, physics, and engineering that have a strong aesthetic component. Students need both knowledge and creativity to

satisfy the demanding requirements of today's complex society, which is changing quickly. Every element of the idea has been developed to value aesthetics.

- As NEP 2020 placed a strong focus on integrated education, this research helps educators understand that integrating arts into the required subjects is urgently needed.
- Students can use art-based inquiry, investigation, and exploration, critical thinking, and creativity for greater learning when the arts are integrated with education.
- Integration of the arts supports the development of problem-solving skills.
- It enables the learner to immediately derive meaning and comprehension from the educational experience.
- The arts integration helps students see cross-disciplinary connections between the various topics and broadens their horizons.
- It results in a positive shift in the students' attitudes towards learning the ideas

5.5 Limitations of the Study

- While conducting the study, there were enough constraints in the data collection process. It delayed the data collection process.
- The schools did not allow for data collection with a fear of covid even though the researcher took precautions has been not approachable by the schools during the Covid.

- Very few schools have provided the resources for conducting the research needed for the study.
- Most of the schools were not ready to permit the experimentation as they were into traditional teaching methods only.

5.6 Recommendations

5.6.1 Recommendations to policy:

1. As per the NEP 2020, Arts integration may be implemented in true spirit by creating professional order of teachers with effective teaching learning process.
2. Prepare the mindset towards Arts integration by intervention programmes, creating awareness and providing support to motivate students to respect their culture and become self-reliant in polishing their innate abilities.
3. Various schemes and support should promote the required skills to impart Cultures and Traditions of India into the school curriculum through Arts integration.

5.6.2 Recommendations to Teachers:

1. Art Integrated Learning must be learned as a means for intellectual work and conceptual understanding.
2. Most of the teachers are not trained in Art integrated skills. Linking different artforms with the other subjects was not achieved due to the lack of proper manuals or module. Therefore, training must be given in such a way that it is learnt systematically and scientifically with a view of efficiency and practical results in implementation.

3. Teachers should know the interest, aptitude, ability towards various art related skills and motivate them to learn and analyse the benefits.
4. Teachers should network with the community craftsman/artists, utilise their services, and encourage children to interact and learn the arts as per their interest.
5. Teachers should encourage children to be involved in the home activities, observe them, connect them to all the concepts, and share the same in the classroom.
6. Teachers should motivate children to visit historical places and know about the history and artforms prevailed during their times, understand the aesthetic sense and learn concepts related to the different artforms.
7. All the teachers should be given professional training in different art forms and provide all other necessary skills to train the students.

5.6.3 Recommendations to Students:

1. Students should engage in art integrated skills with a perspective to explore and learn various concepts.
2. Students need to learn the art integrated skills in which they have interest and aptitude.
3. Students need to explore the concepts through social contacts related to different art forms.
4. Students need to learn various concepts while engaging in learning art forms.
5. Students should understand the importance of arts in creating interest and know the tradition of its society.

6. Students should pick up all the skills related to the art forms and gain professionalism.

5.6 Conclusion

Integrating different art forms into mathematics classrooms was challenging for the researcher. Finding a way to make the mathematics subject appealing to all students is an essential step for teachers. Integrating arts in the mathematics classroom can be considered an incredible way to engage all students and ensure connectivity with the mathematics curriculum. Teachers must look at the curriculum and appreciate the importance of mathematics and the arts. It is important to see students as individuals with multiple ways of thinking, knowing, and representing information. This study concludes with the suggestion that pre-service teachers should be provided with in-depth education on arts integration that presents them with the tools to create a coherent art integrated approach to the mathematics curriculum across age groups in elementary school. In-service teachers should take time to educate themselves on the importance of art education and practice integration across the curriculum, specifically in mathematics, to provide their students with multiple opportunities to express their knowledge. Though many uncertainties in art education will continue to make educators vary of its implementation, the benefits afforded to arts integration through this research, students are a testament to integrations successes and their importance in mathematics.

5.7 Suggestions for Further Studies

Based on the objectives and data analysis of the study, integrating varied art forms into mathematical concepts has made the study analyse only certain concepts. The teachers' perceptions were taken through a self-developed questionnaire cum opinionnaire to understand the significance and scope of Arts integration in the study. At the time of completion, the researcher felt that the field of research was incredibly vast and still a great deal in the area is to be explored. The following studies could be conducted in the Indian context further.

- The study on Arts integration should be done through a Longitudinal Study where in-depth analysis can be done over a long period on the same sample to get accurate results.
- A comparative study can be done based on the different curricula opted in the nation depending on their cultures. Its educational impact can be studied in-depth so that it would be easy and flexible for the teachers to adapt to curricula.
- In-service training programmes are to be conducted in schools to implement this innovative teaching method so that teachers would be given more opportunities for professional development, directly enhancing students' interest in the subject.
- Pre-service teachers are to be trained in art-integrated instructional designs by the educators and make a difference in teaching through joyful learning.
- A study may also be conducted to probe the uses of regional and local culture-specific art forms, and their effectiveness may also be compared.

- A scope can be extended to high school across the disciplinary level and can be studied.
- Through Arts integration, Value-based learning can be studied through varied cultures.
- The interface between school and community for arts integration may also be probed, and its impact can be assessed.
- Studies can focus on evaluation techniques when arts are incorporated in classroom teaching and learning.

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APPENDIX A

MATHEMATICS ATTITUDE SCALE

The Fennema-Sherman Mathematics Attitude Scale measures student attitudes towards mathematics.

This has four dimensions

- i) Enjoyment of Mathematics learning- Q. No. 1 to 10
- ii) Motivation- Q. NO. 11 to 15
- iii) Self Confidence in Mathematics- Q. No. 16-29
- iv) Perceived Value in Mathematics- Q. No. 30-40

Frequency scale

Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

No	Item	1	2	3	4	5
1	I get a great deal of satisfaction out of solving a mathematics problem					
2	I have usually enjoyed studying mathematics in school					
3	Mathematics is present in every subject					
4	I like to solve new problems in mathematics					
5	I would prefer to do an assignment in mathematics than to write an essay					
6	I really like mathematics					
7	I am happier in a mathematics class than in any other class					
8	Mathematics is a very interesting subject					
9	I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in mathematics					

10	I am comfortable answering questions in mathematics class					
11	I am confident that I could learn mathematical concepts other than textbook					
12	I would like to avoid using mathematics in wherever necessary					
13	I am willing to take more than the requires amount of mathematics					
14	I plan to take as much mathematics as I can, during my education					
15	I understand the problem while solving rather than memorizing its formulae					
16	The challenge of mathematics is acceptable to me					
17	Mathematics is the fun filled subject to learn					
18	My mind goes blank and I am unable to think clearly when working with mathematics					
19	Studying mathematics makes me feel uncomfortable					
20	I am always under a terrible strain in a mathematics class					
21	When I hear the word mathematics, I have a feeling of dislike					
22	It makes me nervous to even think about having to do a mathematics problem.					
23	Mathematics does not scare me at all					
24	I expect to do fairly well in any mathematics class I take					
25	I am always confused in my mathematics class					

26	I have a lot of self-confidence when it comes to mathematics					
27	I am able to solve mathematics problems without much difficulty					
28	I feel a sense of insecurity when attempting mathematics problems					
29	I learn mathematics easily/grasp formulae					
30	I believe I am good at solving problems					
31	Mathematics is a very worthwhile and necessary subject					
32	I want to develop my mathematical skill					
33	Mathematics helps me to develop the mind and teaches a person to think					
34	Mathematics is important in everyday life					
35	Mathematics is one of the most important subjects for people to study					
36	Mathematics lessons would be helpful no matter what I decide to study in future					
37	I can think of many ways that I use mathematics outside of school					
38	I think studying advanced mathematics is useful					
39	I believe studying mathematics helps me with problem solving in other areas					
40	A strong mathematics background could help me in my professional life					

APPENDIX B

Achievement Test Questionnaire for Elementary students

This questionnaire consists of three sections

SECTION A

I. Answer the following questions (2X10=20 marks)

- 1.. Write the successor of 100199.
2. Find the HCF of 15, 25 and 30.
3. Find the mean of the following data 24,25,43,26,21,34,36,38,30
4. Write 1298 as a mixed fraction.
5. The length of a young gram plant is 65 mm. Express its length in cm.
6. Which number will we reach if we move 5 numbers to the left of 0.
6. Find the value of the following:
(a) $297 \times 17 + 297 \times 3$ (b) $3845 \times 5 \times 782 + 769 \times 25 \times 218$
7. Which is greater 3^4 or 4^3 ? Explain?
8. Express each of the following numbers as the sum of three odd primes: (a) 21 (b) 53
9. Samson travelled 5 km 52 m by bus, 2 km 265 m by car and the rest 1km 30 m he walked. How much distance did he travel in all?
10. Find the number of right angles turned through by the hour hand of a clock when it goes from
(a) 3 to 6 (b) 2 to 8 (c) 5 to 11 (d) 10 to 1

SECTION B

II. Answer the following (3X 4 = 12 marks)

1. Draw a circle and mark
 - a) Its centre b) its radius c) a segment d) a sector e) an arc
2. a) Look at your watch. How many right angles do the minute hand moves between 8:00 am to 11:30 am?
b.) Name the type of triangle in two different ways triangle PQR with angle Q = 90 degrees and PQ=QR.
3. Raju and prasad purchased 35 note books and 40 note books respectively. The cost of each notebook is Rs. 25. How much amount should they pay to the shopkeeper ?
4. The height data of a class is represented in the table below. Plot the bar graph to show a pictorial representation of the Data.

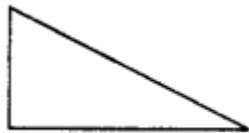
No. of Students	4	3	6	5	6	2	1
Height (in cms)	151	156	153	150	152	154	155

SECTION C

III. Answer the following (1X 15= 15 marks)

1. The rule, which gives the number of matchsticks required to make the matchstick pattern F, is
 - (a) $2n$
 - (b) $3n$
 - (c) $4n$
 - (d) $5n$.
2. The side of a square is l . Its perimeter is
 - (a) $3l$

- (b) 2l
(c) 4l
(d) 6l
3. The monthly salary of Hari Kishan is ₹ 80000. The monthly salary of Manish is ₹ 40000. How many times of the salary of Manish is the salary of Hari Kishan?
- (a) 2 times
(b) 4 times
(c) 3 times
(d) 8 times.
4. There are 25 boys and 25 girls in a class. The ratio of the number of boys to the total number of students is
- (a) 1:2
(b) 1 : 3
(c) 2:3
(d) 3:2.
5. The ratio 40 cm to 1 m is
- (a) 2:5
(b) 3:5
(c) 4:5
(d) 5:2.
6. How many lines of symmetry does the figure have?



- (a) 0
(b) 1
(c) 2
(d) countless
7. Which of the following letters has horizontal line of symmetry?
- (a) C

- (b) A
- (c) J
- (d) L.

8. Observe the following table and answer the related questions:

Blood Groups	No. of Students
A	9
B	6
O	12
AB	3
TOTAL	30

9. Which blood group is the most common?

- (a) A
- (b) B
- (c) O
- (d) AB.

10. Which blood group is the rarest?

- (a) AE
- (b) B
- (c) A
- (d) O.

11. Perimeter of an equilateral triangle

- (a) $2 \times$ Length of a side
- (b) $3 \times$ Length of a side
- (c) $4 \times$ Length of a side
- (d) $6 \times$ Length of a side.

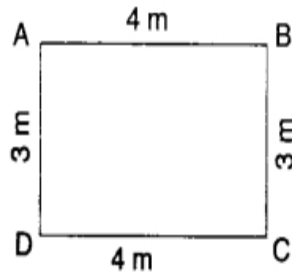
12. Apala went to a park 20 m long and 10 m wide. She took one complete round of it. The distance covered by her is

- (a) 30 m
- (b) 60 m
- (c) 20 m
- (d) 10 m

13. Perimeter of an equilateral triangle

- (a) $2 \times \text{Length of a side}$
- (b) $3 \times \text{Length of a side}$
- (c) $4 \times \text{Length of a side}$
- (d) $6 \times \text{Length of a side}$

14. The perimeter of the figure is



- (a) 12m
- (b) 14m
- (c) 24 m
- (d) 7 m.

15. The speed of Shubham is 6 km per hour. The speed of Yash is 2 km per hour. The ratio of

the speed of Shubham to the speed of Yash is

- (a) 2:3
- (b) 3:1
- (c) 1:3
- (d) 3:2.

APPENDIX C

UNIVERSITY OF HYDERABAD



Teachers Perceptions on Art Integration in Mathematics (TPAIM)

Dear Teacher, I am pursuing my Ph.D. in Education at Department of education and Education Technology, School of Social Sciences, University of Hyderabad, Hyderabad. I request you to kindly fill the questionnaire as the valuable information provided you in needed for my research work. The information provided by you is will be used for research purpose only and confidentiality will be maintained.

Supervised by

Dr. T. Sumalini
Assistant Professor
Dept. of Education and Education Technology
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Instructions

The questionnaires consist of three sections. Kindly give appropriate response under each section.

SECTION I Demographic Information

1. Name of the teacher:
2. Name of the Institution:
3. Curriculum followed: CBSE/ICSE/SSC
4. Classes dealing with:
5. Frequency of Art Integration in classroom
 - daily
 - weekly
 - monthly
 - never
 - biweekly

SECTION II

In this section, opinion of teachers about art integration is recorded, with Likert Scale questions (1 = false, 2 = somewhat false, 3 = neither true nor false, 4 = somewhat true, 5 = true).

S.No.	Item Name	1	2	3	4	5
6.	When I am integrating arts into mathematics, I make my students work with any art form and relate to the mathematical concepts.					
7.	When I am integrating arts into mathematics, I give my students freedom to choose and create their own art.					
8.	I think students can recall information better when the arts are incorporated into mathematics.					
9.	I think students enjoy mathematics more when arts are incorporated into the academic material.					

10.	I enjoy mathematics more when arts are incorporated into academic material.					
11.	The arts do not affect my students' conceptual understanding.					
12.	I do not have time to incorporate the arts in my classroom due to vast syllabus.					
13.	I do oral drilling of formulae in my classroom					
14.	I don't have enough space to use movement effectively in the classroom					
15	I am free to use new teaching strategies in my classroom to be more effective while teaching					
16	I feel confident in my ability to teach visual arts in my classroom					
17	I feel confident in my ability to facilitate performing arts activities in my classroom					
18	I am a creative person in enhancing joyful learning in my classroom					
19	Pressure from curriculum standards prevents me from incorporating the arts.					

SECTION III

20. In my classroom, forms of art used is/are _____

- ☐ music
- ☐ dance
- ☐ drama
- ☐ culinary
- ☐ story telling
- ☐ crafts
- ☐ gardening
- ☐ drawing and painting

- pottery
- Other (Mention if any) _____

21. I incorporate arts into mathematical concepts such as

- Mensuration
- Ratios
- Algebra
- Statistics
- Geometry
- Other (Mention if any) _____

22. In what ways can arts integration benefit students?

23. Why do you choose or choose not to integrate arts into your academic instruction?

24. How do your students react when you incorporate arts into academic subject areas and materials?

25. Do you think art integration supports academic achievement? Why or why not?

26. What do you feel your role is in supporting academic achievement in your classroom?

27. What do you feel is the strongest current motivation for you to use arts in your teaching?

28. What do you feel would motivate you to use arts more than you already do?

29. What professional development have you had (if any) with arts integration ?

30. Elaborate on any anecdote in your teaching experience.

APPENDIX D

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ART AS AN INTEGRAL PART IN TEACHING MATH FOR SKILL DEVELOPMENT AND REDUCE ROTE LEARNING: CASELETS

Dr. T. Sumalini*
K. Sindhu Bhavani**

ABSTRACT

Many students have a critical perception about mathematics. Students are made to believe in memorizing methods and facts rather than understanding the concept and its use in a context. Very few students think mathematics as real joyful learning. It is very critical to change the perception of students' on their learning methods. A paradigm shift is necessary from memorization to thinking critically and conceptually. This study's primary purpose is to develop conceptual understanding and reasoning abilities, explaining, connecting and using logic to link ideas creatively and reduce memorization while learning concepts. Encourage students to be convincing when they reason out. An attempt is made to teach mathematical concepts: Ratios and Volumes with fusion of visual arts and storytelling in the elementary classes. Caselets are developed for understanding the concepts creatively and innovatively while integrating practical aspects. This method supports the students in developing a conceptual understanding creatively without the need for meaninglessly memorizing the facts and formulae.

Keywords: Integral, Rote learning, Conceptual understanding, Caselets

1. Introduction

Revival of art as an integral part in education is getting prominence of late as an approach. Art in Education integrates different art forms into every school subject. It also enables to foster mutual understanding and social inclusion among the students. This has a great possibility in developing creative and vibrant learning environments in the educational institutions. This can be practiced according to the existing need to change the teaching strategies so that it gives an opportunity in encouraging the innovation, imagination, creativity, experimentation and it develops curiosity in the learner's minds. This helps in reflecting on the necessities in course of learning and also in anticipating the educational requirements for the future.

*We gratefully acknowledge ICSSR for the project focusing on documenting caselets in

'Nai Talim for Livelihood Education'

1.1 IMPORTANCE OF ART AS AN INTEGRAL PART OF EDUCATION

Art plays an important role in curriculum transaction. Art needs to become an integral part in the school curriculum and not an extra subject. Art is a form of expression which enables one to express views, ideas, emotions, beliefs and thoughts. Art is of great importance for childrens' all round development, intellectual, social, psychological, educational and moral development.

Art is the best medium to develop creative expression among the learners. It gives an opportunity to create new things. Art is responsible for making other theoretical subjects easy to understand as the students learn the way they wish to learn without any burden. (April, 2001; Goldsmith, 2003; Richards, 2003; Finch

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APPENDIX E

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National Seminar on Revamping Teacher Education in the Context of NEP-2020 (May 5, 2022)	
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Certificate	
This is to certify that Dr./Smt./Shri./Ms K. Sindhu Bhavani, Doctoral Research Scholar, University Of Hyderabad, presented a paper entitled Inclusion of Holistic Development and Life Skills with Aesthetics through Performing Arts in Teacher Education We highly appreciate his/her valuable contribution to the success of this seminar.	
 Dr. Harishankar Singh Director	 Dr. Raj Sharan Shahi Convener
 Dr. B S Gupta Convener	 Dr. Vivek Nath Tripathi Organising Secretary

APPENDIX F

PAPER PRESENTATION CERTIFICATE



INTEGRATION OF ARTS IN MATHEMATICS TO DEVELOP POSITIVE ATTITUDE AND EFFECTIVE CONCEPTUALIZATION

by Sindhu Bhavani K



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