

EFFECTIVENESS OF ART INTEGRATED STRATEGY ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS

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DECLARATION

I, **ARJUN.R.S**, do hereby declare that this dissertation entitled **EFFECTIVENESS OF ART INTEGRATED STRATEGY ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS**, has not been submitted by me for the award of any Degree, Diploma, Title or Recognition before.

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CERTIFICATE

I, **NIRANJANA.K.P**, do hereby certify that the dissertation titled, **EFFECTIVENESS OF ART INTEGRATED STRATEGY ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS**, is a record of bonafide study and research carried out by **ARJUN.R.S** under my supervision and guidance, has not been submitted by him for the award of any Degree, Diploma, Title of Recognition before.

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INTRODUCTION

- *Need and Significance of the study*
- *Statement of the Problem*
- *Operational Definition of Key terms*
- *Variables of the Study*
- *Objectives of the Study*
- *Hypotheses of the Study*
- *Methodology of the Study*
- *Scope and Limitation of the Study*
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Whenever a person decides to learn or decides to teach, a curriculum is automatically born directly or indirectly with respect to the experiences from the life of that person. A person can introduce the term 'curriculum' at the moment he or she recognizes the passive aspects of learning along with the visible active aspects. Whenever a group of persons or society or mass or a nation decide to learn and teach, the idea 'curriculum' become the most powerful instrument towards shifting the momentum of the society. To lead a happy and purposeful life a citizen has to learn many things and the sum of all those are credited under the term education. Thus, in a broader sense, curriculum refers to the totality of all educational experiences with respect to the objectives of learning.

Curriculum has its own explicit, concomitant, societal and hidden nature such that It will be difficult to express in words that what all are the main roles of any curriculum. Curriculum must choose the objectives based on the nature of learner and needs of the society. While thinking on those two aspects, a curriculum designer gets the idea of including various academic subjects, curricular and co-curricular activities, teaching methods, learning activities and a suitable educational environment. But the designer moves confidently to plan those areas under the assumption that he has suitable teachers to transfer those ideas. That is, curriculum designer can plan many useful activities, but only a teacher can really plan how to implement all those. Curriculum must be flexible enough to accept new changes and

innovations through teachers which help to enhance general and specific objectives of the curriculum.

Teaching is an art in which teacher represent information, experiences and knowledge as an expression of self with respect to the objectives of a given curriculum and syllabus. It is considered that good teachers are living embodiment and good performer of ideas, values and knowledge which they teach in front of students both inside and outside the classroom. The moment a teacher is aware that some student is present nearby, teacher automatically becomes an artist who performs the needed demands of student on that occasion in the language of heart both directly and indirectly. Thus, a good teacher is always live in the eyes of his or her student much more than a fan feels about their celebrity artist. Unlike a usual artist playing only at specific settings, a teacher has to perform by creating learning environment whenever he feels the student is willing to learn. In a sense a teacher is both as an artist and director of his own play with dynamic lesson scripts of knowledge which suits the mood of learner. But there, the main job of a teacher is not entertainment, but transforming the learner.

Choosing the right method of teaching creates right mindset among the learner. Based on approaches of teaching, the methods of teaching differ. Behaviorist, Constructivist and heuristic approaches are deciding the attitude of implementing any teaching method. Lecture method, Inductive-deductive method, the analytic and synthetic method, problem solving method, laboratory method and project methods are used in all the approaches based on the needs of the learner. From the ancient history to now, attitude towards methods of teaching has been

shifted from teacher centeredness to child centeredness. This shift expanded the role of a teacher to a more important level such that a teacher has to provide environment to make the child think and construct own knowledge their own.

Today, education scenario of India is going through an era of constructivism in which various innovative activities can be included for transacting the content of any subject. Constructivist strategies are child centered and based on modifying the thoughts of a learner. At the same time, brain based learning practices are also becoming popular all over the world based on many ideas put forwarded by Neuroscientists. Brain based learning and related methods are emphasizing the importance of action and activities in the process of learning. A classroom has to be alive with activities which are going to help in modifying the thoughts of a person. Art Integrated methods can offer advantages of the above two school of thoughts if necessary refining is made. Art integrated methods can be made flexible not only for constructing knowledge but also for feeling and expressing it.

Learning is a process in which the mindset of a learner has to be considered and treated deservingly. Art is a live, attractive way to catch the young minds of primary and secondary level to communicate academic subjects. Even though art is considered as an act of self expression it has multidimensional influence on human minds. Thus, any communication through art forms often creates impact on children and adults. Arts of various types are used to educate citizen for giving awareness and advertisements.

Smith (2004) studied about causes, effects, and preventative measures about math anxiety and found that students who have math anxiety face real and long-

lasting consequences. The Study revealed that there are real methods that teachers can use to help students to overcome their math anxiety. It concluded by hoping that when methods are found to overcome this problem, the ideas and information should be shared so others can benefit from it as well. Above study inviting the attention towards the need of trying innovative strategies and methods in the teaching learning process of mathematics .

Arts integration is related to the concept of arts education practiced in schools. Arts education, while existing in different forms during the 19th century, gained popularity as part of Dewey's Progressive Education Theory. According to Dewey, "Every art communicates because it expresses. It enables us to share vividly and deeply in meanings. For communication is not announcing things, communication is the process of creating participation, of making common what had been isolated and singular. The conveyance of meaning gives body and definiteness to the experience of the one who utters as well as to that of those who listen." (Dewey,1934).

Art integrated strategy is a teaching learning strategy that uses fine arts and performing arts as primary pathways to learning. According to Donavon and Pascale (2012) "Arts integration is the investigation of curricular content through artistic explorations. In this process, the arts provide an avenue for vigorous investigation, representation, expression, and reflection of both curricular content and the art form itself." The John.F.Kennedy Center for the Performing Arts defines art integration "as an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which

connects an art form and another subject area and meets evolving objectives” (Silverstein & Layne, 2010)

In 2000, Lehman College City University of New York initiated a relationship with Lincoln Center Institute(LCI) to integrate aesthetic education into their classrooms during a time of severe budget cuts to art programs. Here the understanding of aesthetic education in the partnership is based on the definition proposed by Greene (2001):”Aesthetic education, then is an intentional undertaking designed to nurture appreciate, reflective, cultural, participatory engagements with the arts by enabling learners to notice what is there to be noticed, and to lend works of art their lives in such a way that they can achieve them as variously meaningful. When this happens, new connections are made in experiences; new patterns are formed, new vistas opened. ” The collaboration between Lehman College and LCI aimed to develop a disposition toward aesthetic education within pre service and in-service teachers.

Need and Significance of the Study

In the curriculum framework of two year B.Ed program of National Council for Teacher Education (2014), drama and art education has included as a part of courses on Enhancing Professional Capacities(EPC). It is said that transformational education involves reflection, introspection and action with a deep relationship between the head, heart and hand. The National Curriculum Framework (2005) emphasized that the school curriculum must integrate various domains of knowledge so that the 'curricular' encompasses all and is not separated from the co curricular or extra-curricular. This has significant implications for the role of art, music and

drama in education, to nurture children's creativity and aesthetic sensibilities. In Kerala, it is seen that the objectives do not visualize the possibilities of familiarizing the latest trends and strategies of learning and performing art and music. The motivational aspects of the programme need a better recognition. The study conducted by Ramachandran (2006) revealed that the teachers dealing art and music at secondary level are unaware about the broad and specific objectives of the programme in pedagogic perspectives.

Variety of art forms is part of our culture. Modern day's facilities help us to use those art forms much easier than before. On the other side, Mathematics is considered as a 'tough subject' by students and even teachers at some situations. To make it easier and overcome fear factor, art forms can be introduced to classrooms in an organized format. Fear of mathematics is a common topic of discussion in any public platform. On the other side, art forms are something which most of the person and children enjoy with a perspective of enjoyment. The present study tried to develop a unique strategy for secondary school students by bridging both the above aspects. Whenever, something innovative or new or unique appears, a community must be vigilant about how much it is going to help in realising basic objectives by satisfying the need of the era which leads to the development of it. Thus, rather than giving importance of only in formation of a strategy, investigator decided to check the effectiveness on achievement in mathematics through a quasi experimental study.

Since art is live communication strategy which is highly dynamic often, there is high scope that art integrated strategy can be experimented in improving the

teaching learning process in schools. Also, it is significant to find out how effective it is in teaching Mathematics which include both abstract and concrete concepts and demanding logical and problem solving abilities.

In academic disciplines like Languages, many of the contents are already in the form a script which can be used to present as an art form. A poem can be sing together or a story can presented as drama in a language classroom. In a History class, fancy dress, acting and dialogue presentation can be used for making feel about incidents, persons and quotes from history. When it comes to the case of science or mathematics, investigator felt the requirement of more active involvement in designing art integrated activities. Investigator was interested in thinking about how to demonstrate, explain the properties and solving the problems related to the concepts like elements, atoms, numbers, geometry, ratio and many other concepts using art forms. And later decided to make an attempt how it would work in a subject like mathematics which include lot abstract ideas, problems, structures and real life application.

Many teachers of Kerala attempted to transact mathematics content through art forms like music and drama. Some teachers are often using art forms for teaching subjects like English, History and Science concepts related to daily life. At primary level, while transacting mathematics concepts, integration of songs related to basic concepts like numbers, basic arithmetic operations were also used. But, when it comes to the case of secondary level such efforts are comparatively less and not promoted often as a part of usual teaching practices in schools. The attempts were made as a part of math club, mathematics fair activities and due to the special

interest of Individual teachers. The teachers working in schools tried to develop musical videos which communicate academic subjects including sciences and mathematics. But, the investigator did not have a clear idea about how much an art form can be effective in teaching Mathematics at a later upper primary stage or in the starting of a secondary stage. Thus, investigator decided to study about the effectiveness of art forms in a mathematics classroom especially at secondary school level.

In the present study, investigator tried a teaching-learning strategy which integrates art forms in learning Mathematics in a regular school classroom. By using popular and possible fine arts and performing arts structures, investigator tried to teach concepts related to ratio in mathematics for eight standard students with respect to the school schedule at the time of data collection procedure. There was a curiosity to find out whether a regular teaching strategy using art integrated activities are suitable in a regular Mathematics classroom and if yes how effective it is on achievement of students.

Here, the investigator tried to experiment the effectiveness of art integrated strategy on achievement in Mathematics among secondary school students. The results of the study will be helpful to curriculum framers and policy makers to incorporate art integrated strategy in teaching of Mathematics. This study enables the teachers and administrators to make a vision about how to use periods for arts and music creatively in schools for learning regular subjects. It also enables the teachers to understand the ways of using art forms for making learning mathematics

interesting which in turn open a lot of thoughts on using art forms for making learning Mathematics more effective.

Statement of the Problem

The present study is entitled as: "EFFECTIVENESS OF ART INTEGRATED STRATEGY ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS".

Operational Definition of Key Terms

Effectiveness

Effectiveness represents the adequate to accomplish a purpose or producing the intended or expected result.

For the present study the effectiveness means the influence of art integrated strategy on improving the academic performance of learners.

Art Integrated Strategy

It is a teaching-learning strategy in which various art forms including fine arts and performing arts are integrated in the process of learning.

Achievement in Mathematics

Achievement in Mathematics indicates the extent to which the learner has internalized the related learning material. The ability of the learner in grasping and applying the concepts of a particular unit in Mathematics by fulfilling the objectives of that unit is considered as achievement in Mathematics.

For the present study, Achievement in Mathematics is operationally defined as the score obtained by the students in the mathematics test developed by the investigator.

Secondary School Students

The secondary school students mean those students studying in VIII, IX and X standards of high schools in Kerala who follows Kerala State Syllabus. For the present study secondary school students means the students of Eighth standard who follows Kerala state syllabus in Kozhikode district.

Variables of the Study

The experimental study consisted mainly of two types of variables viz. the independent variable and dependent variable. The independent variable and dependent variable selected for the study are stated below:

Independent variable

The Independent variable used in the study is ‘Art Integrated Strategy’.

Dependent variable

Achievement in Mathematics was taken as the dependent variable for the present study.

Objectives of the Study

The objectives of the study are as follows;

1. To compare the mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. To compare the mean of post-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
3. To find out whether there exist any significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental group and control group.
4. To find out the effectiveness of Art integrated strategy on Achievement in Mathematics of secondary school students.

Hypotheses of the Study

The hypotheses formulated for the present study are:

1. There exists no significant difference in mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. There exists significant difference in mean post-test scores of Achievement in Mathematics of secondary school students in experimental and control group.
3. There exists significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental and control group.

4. Art integrated strategy will be effective for enhancing achievement in Mathematics of secondary school students.

Methodology of the Study

Methodology deals with the precise description of method used to realize the objectives of the study. The present study used experimental method. The methodology used for the present study is described as follows:

Design of the study

The present study adopted quasi experimental design to compare the effectiveness of art integrated strategy and constructive strategy on Achievement in Mathematics. The pre-test post-test non equivalent group design was used for the study. The notion is given below:

$$G1 \quad O1 \quad X \quad O2$$

$$G2 \quad O3 \quad C \quad O4$$

Where G1 is the experimental group with pre-test O1 and post-test O2 and G2 is the control group with pre- test O3 and post-test O4.

Sample

The population consists of secondary school students studying in standard VIII who follows Kerala State syllabus. The sample selected for the study comprised of 67 students of VIII standard in two classes of C.M.M.H.S.S. Thalakkulathur,

Kozhikode District. Experimental group comprised of 35 students and control group comprised of 32 Students.

Tools Used for Data Collection

The tools used for data collection by the investigator for the present study are:

1. Lesson transcripts in Art integrated strategy.
2. Lesson transcripts in Constructivist format.
3. Achievement test in Mathematics.

Statistical Techniques Used

The collected data were analyzed by using the following statistical techniques.

- Descriptive statistics.
- Test of significance of difference between means(t-test)
- Analysis of Covariance (ANCOVA)

Scope and Limitation of the Study

The present study aimed to develop a regular classroom teaching-learning strategy in Mathematics, using art forms, called Art integrated strategy. This study has an objective to check the effectiveness of Art integrated strategy on Achievement in Mathematics while comparing with constructivist strategy. Investigation opens a possibility to think and have a vision about the nature of teaching-learning strategy incorporating art forms including art integrated strategy.

It can enlarge the vision of teachers and teacher educators towards the possibility of art integrated practices of communicating academic content in various subjects including mathematics. It also gives an insight towards the concept that mathematics can be taught through art integrated strategy as usual teaching method. The study is also helpful in clarifying misconceptions about the practical difficulties about using art forms in teaching mathematics content.

Limitations

Even though the present study was organised with sincerity and maximum possible care with respect to the ability of the investigator, certain limitations which could hardly be avoided, have crept in to the study, they are:

- The study is conducted only in single secondary school of Kozhikode district.
- The competency level and the experience of investigator in teaching and research might have influenced the results of the study.
- Some Students in both the group were absent in few days and might have affected the continuity of grasping the content.
- Investigator used more periods than planned in the experimental group due to various reasons including lack of experience in teaching through art integrated strategy.
- The study was limited to Malayalam medium students only.
- Investigator did not include all art forms including dance.

- Shortage of time has necessitated the investigator to limit the study to check the effectiveness of art integrated strategy on Achievement alone. The study could have been more fruitful if effectiveness on Interest in mathematics and Attitude towards Mathematics has been investigated along with Achievement.
- The comparison was made with constructivist strategy only.
- No treatment was given for equalizing both groups.

Hence, this study has to be read and grasped by keeping above points in mind for a better clarity of the investigation.

Organization of the Report

The report of the present study is organized in the following way.

Chapter 1 includes a brief introduction, need and significance of the study, definition of key term, variables, objectives, hypotheses and scope and limitations of the study.

Chapter 2 includes a brief theoretical overview of the variable, studies related to art integrated strategy variables and a conclusion of review of related literature.

Chapter 3 includes methodology of the study in detail with description of tools used for measurement, sample selected for the study, data collection procedure and the statistical techniques used for analysis.

Chapter 4 describes preliminary analysis, details of the major statistical analysis of the data, interpretation and discussion of the results.

Chapter 5 presents study in retrospect, major findings, tenability of the hypothesis, educational implications and suggestions for the research.

**REVIEW OF
RELATED LITERATURE**

- *Theoretical Overview of Art Integrated Strategy*
- *Review of Related Studies*
- *Conclusion*

REVIEW OF RELATED LITERATURE

Review of related studies and literature is an essential aspect in the development of the problem and towards a sensible solution of it. Related literatures and studies give background and direction to any research theme. It is also helpful in keep on having a self evaluation in each step of research procedure. And results of previous studies related to a specific area are highly helpful in interpreting the findings of new research attempt. A literature is highly influential in having vision and attitude while exploring the various phases of a new study.

Teaching mathematics using art forms is not a new concept while analyzing the curriculum practices of lower primary school. But the need of developing art integrated strategy to teach in secondary school definitely needs a justification in the present scenario of education.

The review of related literature is explained as two sections in this chapter

- Theoretical Overview of Art Integrated Strategy
- Review of related studies

Theoretical Overview of Art Integrated Strategy

Deasy (2012) edited the research compendium named critical links which is a collection of studies that showcases how arts learning experiences affect the academic achievement and social development of children and youth. The focus of the above compendium is mainly distributed into five areas such as dance, drama,

visual arts, music and multi-arts. The study displays critical evidence connecting arts and student achievement. More than 65 distinct relationships between the arts and academic and social outcomes are reported. Based on analyzing various studies, compendium identified six major types of advantages associated with study of art and student achievement. They are as follows:

- Reading and language skills
- Mathematics skills
- Thinking skills
- Social skills
- Motivation to learn
- Positive school environment

Based on the edited research compendium 'critical links', Ruppert(2006) expressed the above six benefits as the ABCs of Arts Learning where 'A' stands for academic, 'B' stands for basic and 'C' stands for Comprehensive and describe those as below.

The ABC's of Arts Learning

The benefits of student learning experiences in the arts are categorised as below:

I. Academic

- Reading and Language Skills
- Mathematics Skills

II. Basic

- Thinking Skills

- Social Skills
- Motivation to Learn

III. Comprehensive

- Positive School Environment

Learning in the Arts is Academic

Learning experiences in the arts contribute to the development of academic skills. Academic skills include areas of reading and language development and mathematics. Using standardized tests, outcomes can be understood. Here, standardized test does not always meant to have only paper pencil tests, but also various innovative measures to identify the achievement.

Certain forms of arts instruction empower and complement reading skills, language development and writing skills. For example, dance has been useful to develop reading readiness in very young children. The study of music has opened a context for teaching language skills. Literacy is a term that refers to the ability to read and write. A chain of processes is involved in the development of literacy skills. By associating with letters, words, phrases, sounds, sentences and meanings children learn to read and write. Music, Drama and dance are useful to develop language among learners.

Certain types of music instruction support for developing the capacity for spatial and temporal reasoning which are integral to the acquisition of important mathematics skills. Spatial temporal reasoning refers to the ability to understand the relationship of ideas and objects in space and time. A recent literature review turned

up over 4,000 published and unpublished references on this topic alone. Those studies revealed that the positive relationship between math proficiency and music.

Learning in the Arts is Basic

Arts learning experiences contribute to the development of certain thinking, social and motivational skills that are considered basic for success in school, work and life. These fundamental skills can span a wide range of more subtle, general capacities of the mind, self-perceptions and social relationships.

Thinking skills (sometimes referred to as cognitive skills) is a broad term that refers to the operation of various thought processes. Reasoning ability, intuition, perception, imagination, inventiveness, creativity, problem-solving skills and expression are processes which involves in strengthening the thinking skills.

Certain arts activities encourage growth in positive social skills, including Self-confidence, self-control, conflict resolution, collaboration, empathy and social tolerance. Research evidence clearly speak these benefits apply to all students, not just to the gifted and talented.

The arts can play a key role in developing social competencies among educationally or economically disadvantaged adolescence. The arts can cultivate an environment suitable for motivating to learn by emphasizing active engagement, disciplined and sustained attention, persistence and risk taking. Participation in the arts is an important strategy for engaging and motivating students come from isolated or marginalised environment.

Learning in the Arts is Comprehensive

Learning in the arts is comprehensive. Integration of the arts as a critical component of the school curriculum can provide students a complete and well rounded education. The benefits associated with study through arts are *inclusive* of all students. And, an arts-rich learning environment can offer far-reaching effects that extend to the school and surrounding community. Art integrated school environment can be a boost to foster teacher innovation, a positive professional culture, community engagement, increased student attendance, effective instructional practice and school identity.

The study of Ruppert based on the book critical evidence is concluded by indicating that the arts contribute to student achievement and success. And also found the multiple benefits of learning through arts can be categorized as academic, basic and comprehensive. Author also indicated that creating opportunity to all students to learn through arts and experience the arts in school is a very important need of the educational community.

Any unique teaching strategy is a culmination of thoughts and practices developed in the history of education. Art Integrated Strategy is natural evolution of thoughts like art integration, art education and using art for transacting the content practiced in various nations and situation in the world. It is possible to identify many attempts made in the past to incorporate art forms to make teaching –learning process effective in various levels of schooling.

Silverstein and Layne (2010) describe the creative process in the art integrated environment as a process which is not a one way flow of events. The heart of arts integration is engagement in the creative process. Arts integration encourages students to do more than repeating, copying or follow directions. They must create something that is original and of value. It includes many interacting phases and each phase is connected to all other. There are many descriptions of the creative process. The one provided here is a synthesis of ideas from various sources. The creative process in a art integrated learning environment is made visible as five open circles as follows:

- 1) Students imagine, examine, and perceive.
- 2) They explore, experiment, and develop craft.
- 3) They create.
- 4) They reflect, assess, and revise
- 5) Share their products with others.

Arrows indicate the ways one can enter the process and the myriad ways the phases interact. When students engage in the creative process, they produce original work that communicates their ideas, insights, points of view, and feelings. The creative process may look like unstructured or confusing at some situation especially in the beginning. But, original outcomes may appear unexpectedly from a single event or thought. Art integrated teachers have to be creative to make the children to be creative the way they want to make outcomes.

Figure 1 given below, demonstrate the above concept:

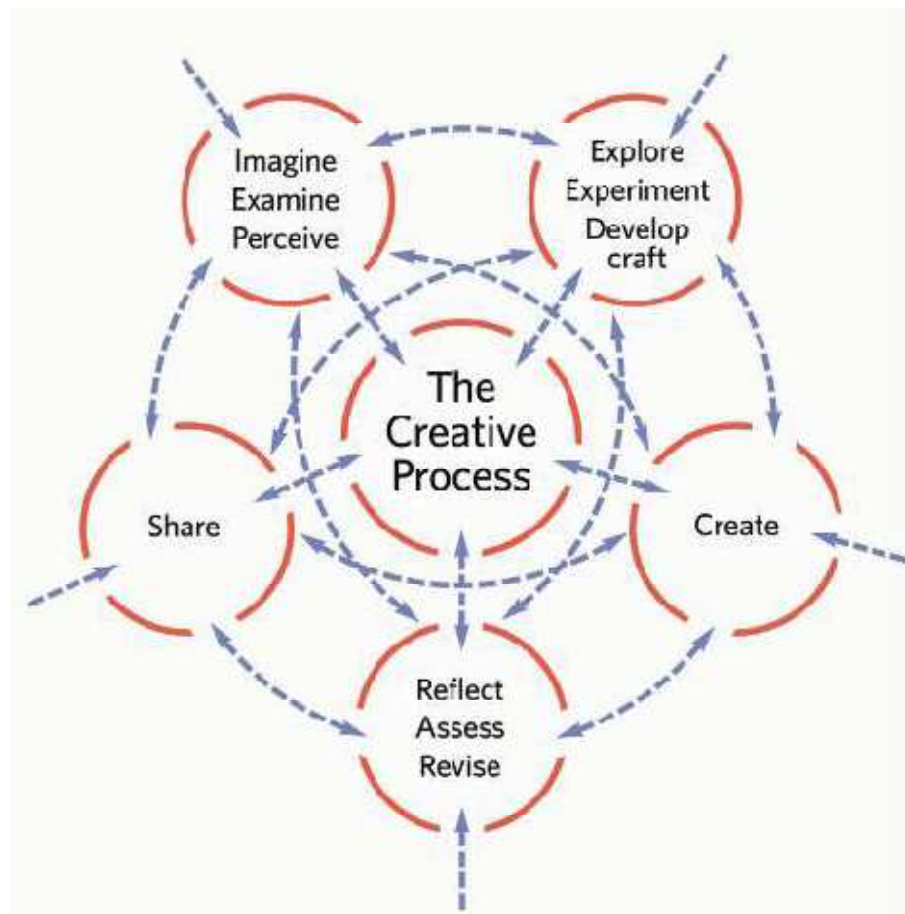


Figure 1. Demonstration of creative process in art integration

Chicago Guide for Teaching and Learning in the Arts published by Chicago Public Schools (2010) displays a direction towards executing the idea of art integration by creating more opportunities by ensuring more connections among disciplines lead to a variety of instructional choices and execution. It also indicates the following concepts which can be used as a standard for planning and evaluating an arts integration program.

1) Establish clear instructional goals:

Since art forms and an academic subject are interfering together in instruction, establishing clear learning objectives for each subject will produce the best outcome. A good lesson transcription will incorporate goals for both disciplines (arts and academic subject) and align with state standards and resources. As teacher identify learning goals for the specific unit, consider the theme students can focus on. Substantive, engaging activities are important. Teacher has to prepare in mind and plan which warm-up activities are suitable and which activities best support teaching in the content area.

2) Collaborate:

A teacher can collect ideas and contributions from other teachers, artists and experts to design suitable lesson transcripts. Expertise and experience of other persons can strengthen the plan one's own.

3) Take notes:

Art Integrated teacher has to reflect upon daily events in the classroom and can make a note or record on it to improve the future sessions. Capturing experiences and insights along the way provides inspiration for new and effective way to execute arts integration units for the later periods.

4) Support and enhance sequential learning:

Arts integration programs can be most valuable when they support and enhance sequential and standards-based learning for both the art forms and concept described as a part of academic subject being taught. Sequential arts

instruction can support the Children to learn at suitable pace and to expand based on previous knowledge.

5) *Assess outcomes for all integrated instructional areas*

A teacher has to plan in advance when and how to measure students' progress in both art and academics instructional areas. Pre-assessment, formative assessment and summative assessment all have important roles in helping teachers to achieve their instructional goals.

6) *Communicate plans to students*

Explicitly tell students and ensure that they know what the instructional objectives of the unit are and how the art integrated activities and methods are chosen. Explain in advance when assessment will take place as well as the content and form of the assessment. Provide opportunities for them to express the theme-based or inquiry based connections derived due to the activities in the class.

7) *Engage educators school-wide in arts integration goals.*

Arts integration planning should include communicating with the school principal and other classroom teachers for exploring wider scope performance and infrastructure facilities.

8) *Be flexible*

Execution, development and evolution of art integrated practices have to be flexible. If necessary a teacher can use the help of artists for the better transaction of the content and comfort of the students.

9) Choose an organizing theme or question.

Keep in mind that the organizing themes and questions should foster learning in all of the integrated subject areas. Learners have to get opportunity to construct and express the content through exploring theme or questions presented in the classroom.

10) Emphasize process over product.

In art integrated classroom, presenting a theme, understanding, constructing, demonstrating and expressing are very important. Each process here is very important from aspect of the development of a learner. Hence, the teacher has to ensure the way of happening of process inside a classroom.

11) Align instruction with standards and benchmarks.

Instruction and activities must be suitable to standard and benchmark of the syllabus recommends. Every type of learner has to be comfortable and able to expand the knowledge with respect to their potential irrespective of gifted or slow learners.

Review of Related Studies

Reber and Sherrill (1981) showed that dance can be used to teach creative skills to deaf students. Twenty, hearing impaired children were tested on the Torrance figural creativity measures. Half were assigned to ten weeks of dance training and half to no training. The students receiving dance instruction improved in creative thinking over and above those not in dance classes.

Horn (1992) conducted a study which took place over an academic year in the "theatre institute" at a New York City high school—a magnet school within the school. It was about the *Writing of Original Scripts by Inner-City High School Drama Students*. The students of Tenth and Eleventh grade had studied various aspects of theatre an hour per day. Researcher designed a program which have established guidelines and training modules aimed at student playwriting. The researcher used a variety of strategies to document the class. Instruments included interviews, tape recordings of student discussions and scene rehearsals, observations of audience reactions, and reports of other teachers and the school principal. The researcher also administered pre- and post-questionnaires. The researcher and students maintained regular records of events. Researcher encouraged students to write and perform plays of their own and created situation for it. Several students left the researcher's program during the course of the school year. And the researcher obtained a full set of observations and other data for 29 students. Even though students were bit hesitating in the beginning to write the scripts, students slowly became more pro-active. They started feeling responsible for their ideas rather than receiving ideas from the researcher. Students provided evidences of important growth in self-perception and behaviour over the year. Students increasingly saw themselves as leaders and as important members of the class. Library registration increased from 25 percent to 85 percent of the class over the year. The percentage of students who felt that they knew how to contribute for a play went from 25 percent to 57 percent. Overall, they were able to start overcoming their own personal problems and learning issues by giving way to sustained activities. This indicates a notable improvement in the perception and thought patterns of those 29 students.

Catterall (1995) also viewed that teachers who are supported for integrating arts activities make a noticeable change in their teaching. The study also suggested that the Support for the arts can occur at the school level, colleague level, and administrative level.

Costa- Giomi (1999) conducted an experimental study exploring the effects of piano instruction on cognitive development. Experimental group consisted of 67 children and 50 students in control group. At the beginning, there were no difference in cognitive, motor abilities, self esteem and academic achievement. After training, the musical treatment group improved in general cognitive and spatial abilities. But overall improvement was small in other aspects.

Fiske (1999) indicated that schools with strong arts programs had supportive administrators who played a central role in ensuring the continuity and depth of provision. Those administrators encourage teachers to take risks, learn new skills, and broaden their curriculum.

Bahr and Christensen (2000) assessed the musical and mathematical ability in 85 ten year old students. Various mathematical skills and musical skills of students are analyzed. The study found a significant correlation, but only for mathematical skills that hold a structural relationship to musical skills. The kinds of skills that were argued to overlap were not specified.

Winner (2001) examined about arts and academic improvement and revealed that the arts have typically played a relatively unimportant role in American schools. Arts educators have tried to strengthen the position of the arts in schools. The arts

could help children learn to read and write and calculate and understand scientific concepts. The reasoning was clear: perhaps schools under pressure would value threats because the arts strengthened skills in “valued” areas. This approach became a favoured strategy in the United States for keeping the arts in the schools.

Anvari, Trainor, Woodside and Levy (2002) examined between music perception skill and reading. The sample taken was 100 children between the age limit of 4-5 years. Regression analysis was done. It indicated that music perception skill predicted reading ability above the influence of phonological awareness and cognitive abilities. The study pointed out that both linguistic and non linguistic auditory mechanism is involved in learning.

Nering (2002) examined about the effect of music education on intelligence of monozygotic twins. The author selected ten children between the age group of 3-7 and gave seven months of piano instruction consisting of two private lessons. Each of these children was a monozygotic twin and each child’s twin was assigned to a control condition with no music training. Groups were equivalent in pre-test. The result revealed that music trained children showed significant improvement in verbal. The verbal score was carried by only two sub test they are information and arithmetic.

Garaigordobil and Peereez (2002) assessed the effects of the Ikertage arts programme on verbal and figural creativity. Experimental group comprised of 89 students and control group included 49 students. Ikertage arts programme were followed by the experimental group and control group followed traditional

curriculum in art education. There found a positive effect of the multi arts programme on verbal and figural creativity.

Byun (2004) studied the impact of arts educational programme with picture books and creativity. Here the sample selected was 111 children having 5 -6 years of old, with similar socio – economic background. Different instructional activities were given to the experimental group. Activities like drawing, painting, fine arts , body expression etc. And common activities were given to the control group. Both group showed no difference on tests at beginning of the intervention. After participating in the art activities experimental group showed higher scores in all forms of creative activities.

Oreck (2006) investigated about the particular characteristics and dynamics that encourage or limit arts use in teaching. The study suggested that overall creative outlooks as opposed to specific skill sets was a major factor in determining arts use in classrooms. The teacher's ability to bring the arts into the classroom allowing students to truly explore and make discoveries, find and pursue problems, arrive at unique solutions, and communicate in multiple modalities –thus requires both an artistic pedagogy and an understanding of the aesthetic qualities of experience .

Wandell, Dougherty, Ben-Shachar and Deutseh (2008) examined the association between music training and reading fluency. The investigators conducted their experiment in forty nine children in the age group of 7 -12. The results showed that the music training helps to improve reading fluency in students.

Sridevi (2008) conducted quasi-experimental non-equivalent pre-test and post-test design to explore effectiveness of constructivist approach on students

achievement in science, scientific attitude and perception of nature of science at secondary level. Purposive sampling technique was adopted. The sample consisted 8th standard students of demonstration multipurpose school and Kendriya Vidyalaya located in Mysore of Karnataka. Revans progressive matrices, achievement test in science, perception natural science test, science process skills test, scientific attitude scale, attitude towards science scale, reaction scale and semi-structure interview were the tools used in this study. The investigator developed 4 E's based constructivism approach instructional material and taught in experimental group. And control group was taught on regular basics by the science teacher. After intervention post-test and other tools were employed to both students. For analysis and interpretation t-test, persons' product movement correlation and analysis of covariance test were employed. The findings of the study were; constructivist approach was effective than tradition approach in improving the academic achievement in science, perception of natural science process skills, scientific attitude and attitude towards science.

Solangi, Mughal and Qaisrani (2008) studied the effect of constructivist teaching approach on the achievement of mathematics students at secondary level. The main objective of the study was to examine whether constructivist based instruction is better than the traditional approach in teaching of 10th class mathematics. The study adopted pre-test post-test control group design in the study. The Population of the study was 200 students of class X from government boys high schools situated in district Naushehro Feroz. The study was conducted on randomly assigned 30 students each for experimental and control group. In experiment

procedure experimental group was addressed with constructivist teaching and control group with traditional approach. The total hours allotted for treatment for each group was 30 hour. Multiple choice questions based pre-test and post-test constructed by researcher was used to collect data pertaining to achievement in mathematics subject. SPSS package was used to calculate mean, SD and t-test. The findings of the study were; there was statistically significant difference between pre-test and post-test scores of experimental group and control group. There was significant increase in the mean scores of experimental group (N=30, M=38.683) compare to control group (N=30, M=26.973). Therefore, constructivist approach was more effective than the traditional approach.

Cokadar and Yilmaz (2010) investigated the science understanding outcomes of 12-13 year old students in Turkey through an experimental study. Learners in the experimental group were taught through a method named 'creative drama-based instruction' while control group through traditional instruction. Classes were randomly assigned for the study and were taught by the same science teacher. Both the groups taught the topic 'ecosystems and matter cycles'. In the experimental group, students were asked to represent scientific concepts through movements and actions. And in the control group, lessons were delivered via lecture and discussion. Even though both the group did not differ in attitude towards science, the experimental group showed greater gains in scientific concept understanding than the control group. The researchers observed that the benefit of creative drama-based instruction comes from the fact that it is less passive than traditional learning and may also be more enjoyable.

Nayak (2011) conducted an experimental study on the effect of problem based learning strategy in constructivist framework on different dimensions of mathematics achievement of class-IX students. The study used non-equivalent pre-test post-test quasi experimental design to compare the achievement of students in mathematics subject in experimental and control group. The sample consisted of 155 students of IX class studying in two schools of Bhubaneswar in Orissa. The first school comprised of 65 students in which 33 students in experimental group and 32 in control group. The second school includes of 90 students, in which 45 students each in experimental and control group. Here experimental group was subjected to 5 E's Learning cycle based constructivist problem strategy and control group with traditional teaching. For collection of required data, achievement test in mathematics was used, which consisted of 30 items and validated by the expert to measure the achievement of the students. The t tests, ANCOVA were used in the study for data analysis. The study revealed that there was a significant difference in the academic achievement of student in experimental and control group. ANCOVA analysis reveals that treatment influenced on the students to gain higher academic achievement in experimental group than the control group. There was no significance difference between experimental and control group in respect of knowledge and skill in Math's where experimental group demonstrated higher achievement of understanding and application than the control group

Nevanen, Juvonen, & Ruismäki (2012) investigated about art education and multi professional collaboration. The multi professional collaboration pair in this study consisted of an artist working together with a teacher. The aim of the project was to familiarize children with the history of their home district through art, using

methods related to their own work and experiences with art. One target was to enrich children's imagination and to encourage them to make and experience art during the everyday routines of kindergarten and school. There were approximately 1500 children and 400 teachers from local kindergarten's and schools, and 20 art specialists from different fields. The children's parents also broadly participated in the project. The visual arts, environmental art, literary art, drama, circus and architecture subprojects were carried out in cooperation between artists and teachers. The result revealed that the teachers saw art education as an excellent child centred way to go through the main contents of preschool and kindergarten. The artists made it possible to carry out a whole artistic process including high quality outcomes integrated within the normal achievement of kindergartens and schools.

Masoum, Rostamy-Malkhalifeh and Kalantarnia (2013) studied about the effectiveness of drama activities on understanding mathematical concepts among grade three students of Iran. Study was conducted among elementary school girls who were studying in grade three. Quasi experimental method was used for the investigation. Author framed drama as an empirical aspect of learning and 36 children in experimental group were provided the environment to learn mathematics from the activities which they do for drama. Author observed children were so active instead of having a passive shape in drama. Kids were learning mathematics, finding experiences and new paths from drama as well. The results of the study clearly showed that the drama activities for understanding mathematics have worked better than the traditional teaching. Then it concluded that cited method is suitable for elementary students to learn mathematical concepts.

Williams (2013) studied about the attitudinal factors of teachers regarding arts integration. The study included both quantitative and qualitative components of the problem and examined the attitudinal factors possessed by educators in schools who participate in the whole schools initiative and those who do not. The study also reported the perceptions of arts integration by classroom teachers who participate in the whole schools initiative and those who do not participate in the whole schools initiative. Some teachers responded that knowledge of research which conveys that the arts can increase student achievement and should be connected with core content areas. Another finding of the study is that self-efficacy within teachers using the arts in their classroom should be strengthened. Many teachers desire training in arts integration. In the conclusion of the study it is mentioned that receiving such training could actually build their self-efficacy when using the arts in their classroom which could enable them to become more proficient arts integration teachers. The results of the study also reported that if the teachers receive more support includes example lessons, modelling, seeing how a lesson can cover multiple objectives, being able to talk with successful arts integration teachers, collaborating with contracted teaching artists, and learning about the elements and principles of specific art forms they would be more motivated to use the arts more regularly in their classroom. Many of the respondents expressed their views about getting the support from administrators would motivate them to use the arts more frequently as an instructional strategy.

Conclusion

According to Young, there is no subject except the use of mother tongue which is so intimately connected with everyday life and so it is necessary to successful conduct of affairs as Mathematics. As per the words of Merriam-Webster dictionary(2016), Mathematics is the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configuration and their structure , measurement, transformations , and generalizations ,and abstractions and of space configurations and their structure ,measurement, transformations, and generalizations. Above words reflects the nature of Mathematics in various dimensions. Secondary school mathematics is a phase of beginning of familiarizing with the real nature of mathematics. From the perspective of mathematics education, understanding a mathematics concept and internalizing it by a learner is the main vision of any teacher or curriculum. This requires efforts to transform the thoughts of the learner to think in terms of loving the nature of mathematics irrespective of how abstract, how interrelated or how structured the mathematics concepts are.

Studies mentioned in this chapter reflect that art integrated practices can be helpful in enhancing academic achievement and other areas of learning. Also, power of constructivist vision in teaching learning process is also displayed. Hence, the results of the present study cannot be predicted theoretically in advance easily.

Different subjects have been taught using art forms including mathematics. In West, there are experimental schools which practice art integrated format to

teach various subjects including Mathematics, Science, Social Sciences and other academic disciplines. But, investigator could not find or still searching any practice or formats which are practiced or experimented as a regular strategy suitable to common school system in which the children of most of the citizen study. Hence, as per the view of the investigator this is an innovative attempt to design a strategy suitable to regular school system of Kerala which follows Kerala State syllabus.

METHODOLOGY

- *Variables of the study*
- *Objectives of the study*
- *Hypotheses of the study*
- *Design of the study*
- *Sample selected for the study*
- *Tools used for data collection*
- *Data collection procedure*
- *Scoring and consolidation of data*
- *Statistical techniques used for analysis*

METHODOLOGY

Methodology is important in any type of research. In an experimental study, clarity in methodology helps in smooth execution and genuine derivation of results in any sample. Methodology describes the procedures and techniques used in research study. "Methodology is the science of methods or principles of procedures." (Good, 1945).

Method refers to be formal structure of the sequence of acts commonly denoted by instruction. The term method covers both strategy and tactics of teaching and involves the choice of what is to be taught, and the order in which it is to be taught (Mouly, 1963). Methodology consists methods of study, sample selected, variables of the study, tools used, techniques used, statistical procedures used for analysis and identification of the results. A suitable method create environment for having a scientific and feasible investigation of the problem in the selected sample. Methodology can assist in planning, transparency and objectivity of the study in any formal and informal research attempt. It helps in utilizing efforts, time, money and infrastructure facilities of the society effectively without having any wastage.

According to Barr (1960), "The machinery of methodology occupies a very important position in any kind of research, as the validity and reliability of the findings depend upon the method adopted". Methodology reflects how the study is going to be conducted, what actually the study is in practical and why the study has to be in this way.

In the present study, the investigator tried to study the effectiveness of art integrated strategy on Achievement in Mathematics among secondary school students. This study is attempted through quasi experimental design to derive the findings by comparing with the outcomes of constructivist strategy. Details of methodology followed for the successful completion of the study has been discussed under the following heads.

Variables of the study

Objectives of the study

Hypotheses of the study

Design of the study

Tools used for the study

Sample used for the study

Data collection procedure, scoring and consolidation of data

Statistical techniques used for analysis

Variables of the Study

“Variables are the conditions or characteristics that the experimenter manipulates, controls or observes” (Best & Kahn, 2014).

The experimental study consists mainly of two types of variable viz. the independent variable and dependent variable. The independent variable and dependent variable selected for the study are described below:

Independent variable

In experimentation the manipulated variable is called as independent variable. It is under direct control of experimenter who may vary it in any way desired. The Independent variable used in the study is 'Art Integrated Strategy'.

Dependent variable

The dependent variable is the condition or characteristics that appear, disappear or changes as the experimenter introduces, removes or changes the independent variable. 'Achievement in Mathematics' was taken as the dependent variable for the present study.

Objectives of the Study

The objectives of the study are as follows;

1. To compare the mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. To compare the mean of post-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
3. To find out whether there exist any significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental group and control group.
4. To find out the effectiveness of Art integrated strategy on Achievement in Mathematics of secondary school students.

Hypotheses of the Study

The hypotheses formulated for the present study are:

1. There exists no significant difference in mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. There exists significant difference in mean post-test scores of Achievement in Mathematics of secondary school students in experimental and control group.
3. There exists significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental and control group.
4. Art integrated strategy will be effective for enhancing achievement in Mathematics of secondary school students.

Design of the study

Experimental design is used for this study. “Experimental design is the blue print of the procedures that enable the researcher to test hypothesis by reaching conclusion about relation between independent and dependent variables. Selection of particular design is based upon the purposes of experiment, the type of variables to be manipulated and the conditions or limiting factors which it is conducted (Best & Kahn, 2014).

Experimental method is the description and analysis of what will occur under careful conditions. In the field of education, especially in the area of secondary school education, experimental methods have high relevance. Any experimental research study can contribute to make our teaching learning process a better one in real classrooms. Also such studies are helpful in modifying our real classrooms by receiving direct responses while experimenting and present in front of stake holders. “Experimental research is used to determine and evaluate the adequacy and effectiveness of the educational and instructional objectives through the measurements of their outcomes .After evaluating the efficacy of objectives, the suggestions are made for the formulation ,execution and modification of educational programmes and classroom practices” (Koul, 2009)

The present study adopted quasi experimental design to compare the effectiveness of art integrated strategy and constructive strategy on Achievement in Mathematics. The pre-test post-test non equivalent group design was used for the study. The notion is given below:

$$G1 \quad O1 \quad X \quad O2$$

$$G2 \quad O3 \quad C \quad O4$$

Where G1 is the experimental group with pre-test O1 and post-test O2 and G2 is the control group with pre- test O3 and post-test O4.

The non equivalent pre-test post test group design uses two non equivalent groups. One group is known as experimental group and the other is control group. The investigator adopted non- equivalent pre-test post-test group design for the

study in which experimental and control groups are naturally assembled groups as intact classes. In this design the subjects are assigned to the experimental and control groups by random procedures and administered achievement test as pre-test in both groups. After the administration of the pretest the investigator taught the experimental group through Art Integrated Strategy. Simultaneously, same unit was taught through constructivist strategy by the same teacher to control group too. After completion of transaction of units, post test was conducted to both groups. To analyze the scores obtained by the students of experimental and control groups, the investigator used statistical techniques Test of significance of difference between means (t-test) and Analysis of Covariance (ANCOVA).

Even though, the equivalent group design would have been more suitable for this experiment, in current school situation it might disturb class schedule and academic plan. Hence, investigator decided to conduct the experiment with non equivalent classroom groups.

Two class divisions from same school were selected as experimental and control groups. Experimental group was taught through art Integrated Strategy and the control group was taught through the constructivist method of teaching. Fifteen lesson transcripts were prepared in both the formats. Each lesson plan was prepared to teach for a period of 40 minutes. Investigator prepared and taught in both the groups. Even though the plan was to execute the lesson transcript in fifteen periods, it took eighteen periods for completing the lesson transcripts in art integrated classroom whereas fifteen periods in constructivist classroom.

Since the design selected for the present study was pre-test—post-test non equivalent group design, prior to introduction of two teaching methods, both groups were administered the same achievement test in both the groups. Also same achievement test is administered as post test after the execution of lesson transcripts. The flow chart showing the design of research is given in Figure 2.

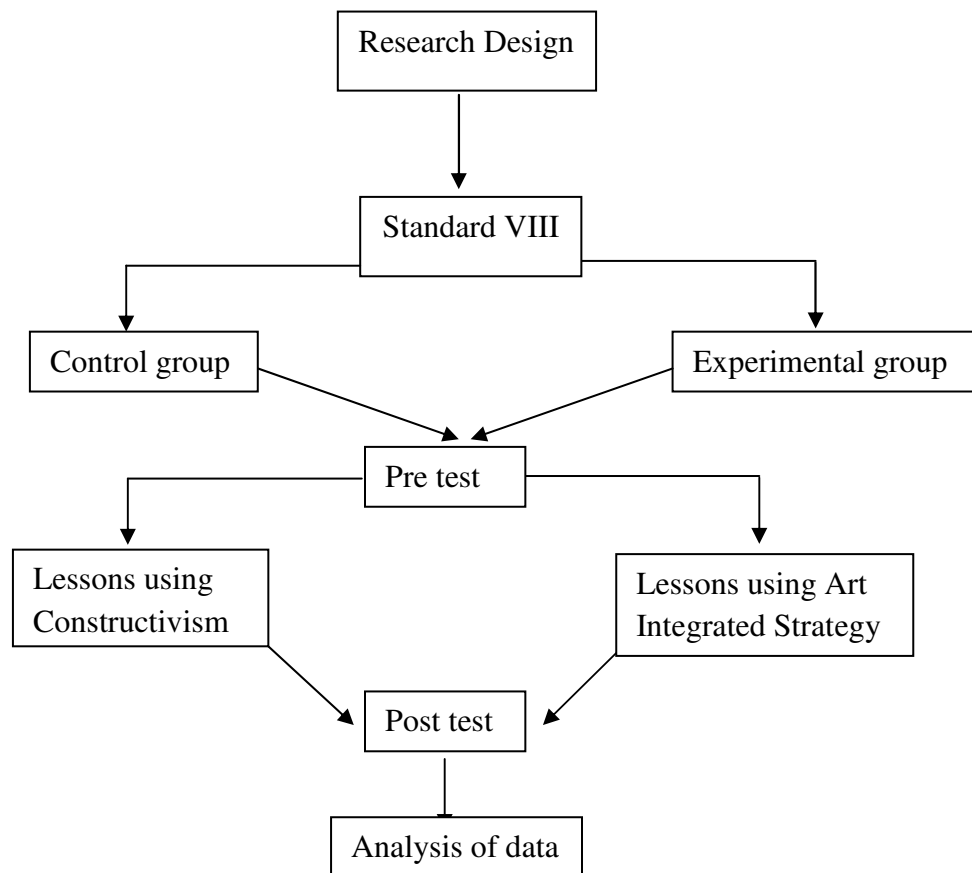


Figure 2. Flow chart showing the design of research

Sample Selected for Study

All the items are under consideration in any field of inquiry constitute a population. Population of the present study covered all the secondary school

students studying in VIII standard of Kerala State who follows Kerala State Syllabus.

Sample is a proportion of a population selected for observation analysis. The sample selected for the present study comprised of 67 students of VIII standard in two classes of C.M.M.H.S.S.Thalakkulathur, Kozhikode District, and Kerala. Experimental group comprised of 35 students and control group comprised of 32 Students. The details of sample selected for the study is given in Table 1.

Table 1

Details of Sample selected for the study

Standard	Experimental Group			Control Group		
	Boys	Girls	Total	Boys	Girls	Total
IX	21	14	35	20	12	32

Tools Used for the Study

The selection of suitable and appropriate tools or devices for the experiment and data collection is very important for a successful research. For collecting new unknown data required for the study of any problem, various devices called tools are made use of. The present study intended to find the effectiveness of art integrated strategy on Achievement in Mathematics among secondary school students. Here, lesson transcripts in art integrated strategy are prepared along with lesson transcripts in constructivist method on the same topic to do an experimental study. The tools used to realize the objectives of the study are:

1. Lesson transcripts in Art integrated strategy.(Niranjana and Arjun,2016)
2. Lesson transcripts in Constructivist format.
3. Achievement test in Mathematics.(Niranjana and Arjun,2016)

Details regarding the tools are given below.

Lesson Transcripts based on Art Integrated Strategy

Investigator collected various sources which demonstrate and experimented transacting mathematics concepts at different levels through various art forms including music, dancing and acting. Also various art forms were observed and checked from the view converting those as a method for teaching mathematics at secondary level. Through number of discussions with experts in art forms, mathematics, mathematics teaching, education and educational research, way of transacting through art integrated strategy was designed suitable with respect to the data collection schedule.

After exploring the content of standard VIII mathematics textbook of Kerala State Syllabus, Malayalam Medium developed by SCERT, the investigator in consultation with the supervising teacher selected the chapter “Ratio” for the experimental study. The learning activities suitable for the lesson were chosen by integrating art forms, various videos of art integrated experimental schools working in aboard were also checked in order to improve the classroom atmosphere and mathematics transaction. Art forms were modified to make fit in the classroom duration and with respect to learning objectives.

The various art forms used in lesson transcripts of art integrated strategy to transact the unit “Ratio” are as follows:

1. Acting
2. Imitation
3. Singing (Solo)
4. Writing
5. Drawing
6. Painting
7. Mimicry
8. Kathaprasangam
9. Miming
10. Drama
11. Dumb Charades
12. Story making
13. Story presentation
14. Group Songs
15. Action Songs
16. Puppet play

Design of Lesson Transcripts in Art Integrated Strategy

Lesson transcripts are effective tools in the hands of any teacher. The teacher needs a lesson plan showing the different steps to be followed by him logically at the right moment at various situations. Lesson plan is virtually pre-active phase of teaching.

Based on the content and art forms used, lesson transcripts were written by including the following aspects:

1. Learning objectives.
2. Art forms used
3. Materials required
4. Prerequisites
5. Activities
6. Follow up Activity

Learning Objectives:

Here learning objectives of a particular topic is mentioned in each lesson transcript. Based on the content and curriculum objectives, the learning objectives of the lesson were selected by the investigator. They are chosen mainly on the basis of the concepts and content in the chapter 'ratio' which eighth standard students have to be perceived.

Art forms can be used to develop many behavioral and social changes among learners. Hence, objectives are mentioned from the view of cultivating such positive changes among future citizen with respect to the selected art forms. Since each art form are different in many aspects, effect it create among students too can be different. Also, preparation and presentation of art forms varies in many aspects like individual-group, fine arts-performing arts and with movements-without movements. Hence, an art form can be used to have unique changes in pupils not only as individuals but also as team. Certain art form may use to cultivate

cooperation among children while learning or creating mutual understanding, certain is used for improvement in communication skills or for encouraging each other and so on. The objective behind using a specific art form is mentioned in the lesson transcript.

Art forms used

Here, teacher listed out the various the art forms used in the class for teaching a particular topic. Art forms are chosen with respect to the content in the chapter, duration of the period, practicability and the individual comfort of the teacher in transacting the content. And art forms are modified with respect to the classroom situation.

Materials required

Each art form requires different type of materials to be executed and performed. Since it is mathematics learning environment, additional materials required for learning were added. The investigator mentioned the various materials used in teaching-learning process in the lesson transcript.

Pre Requisites

The previous knowledge and information the student should acquire for understanding the topic were indicated in the lesson transcript.

Activities

Lesson transcripts contained one or two activities. Description of planned activity is mentioned in this section. Here, the way the teacher planned to execute

the activities are described briefly. How the content is transacted in classroom by using art forms is narrated in this section. Songs, stories, dialogues, scripts and important direction to do the learning activity were described. Needed information and content were described briefly in the case of certain activities. Activities are designed flexibly with respect to the nature of art form and content.

Follow up activity

Based on the activities happened in the classroom, certain activities are presented in front of students to do after the class or at home or later. Such activities are given to feel the content better and internalize the ideas through the help of art forms.

Validation of the lesson transcripts in Art Integrated Strategy

The lesson transcripts prepared based on art integrated strategy had to be validated by the experts in order to be implemented at secondary school level. Thus, the investigator showed the lesson transcripts to experts in the field of secondary school mathematics teaching and mathematics teacher educators. The lesson transcripts were discussed with the experts in the educational research too. The investigator incorporated the guidance and suggestion given by the experts and prepared the lesson draft of the art integrated strategy. A sample of validated lesson transcripts of Art Integrated Strategy is given in Appendix I.

Lesson Transcripts in Constructivist Format

The lesson plan for teaching in the control group was prepared in constructivist format which was followed by the teachers practicing in secondary

schools of Kerala State. The details of constructivist lesson transcripts are given below:

1. Content Analysis
2. Learning Outcomes
3. Process Skills
4. Pre Requisites
5. Learning Materials
6. Process

Content Analysis

Here the terms, facts, concepts and principles related to the topic were mentioned in the lesson transcript.

Learning Outcomes

The learning outcomes section mentioned the learning outcomes which teacher expects from the students by teaching a particular topic. They are further classified as short term learning outcomes and long term learning outcomes.

Process Skills

Skills of students may express to learn through the activities in relation to the topic were mentioned.

Pre Requisites

The information the student should required for understanding the topic was mentioned under pre requisites.

Learning Materials

Here, the learning materials used in the teaching-learning process were mentioned.

Process

The process involved introductory activities, development activities and consolidated activities for transacting the content. The introductory part of the lesson was given in an interesting way by including some interesting questions which will bring the students to the new topic which the teacher is going to teach. Here some activities were included in this section. Some thought provoking questions related to each and every activity was also included. Consolidation was done after each activity or after a presenting a concept completely or at the end of the class.

Follow up Activities

Some questions were given for the students so that they can internalize the topic they learned and they will start applying it in further situations.

A model lesson transcript based on constructivist format is given as Appendix II.

Achievement Test in Mathematics (Niranjana & Arjun, 2016)

For testing the effectiveness of the student's performance of the topic, the investigator conducted a pretest and post test by using the same Achievement Test in Mathematics. For the pre-test and post-test, an Achievement Test in Mathematics (Niranjana & Arjun, 2016) developed by the investigator in collaboration with the

supervising teacher was used. The test items were prepared on the basis of a blue print by giving proper weightage to content, thinking skills, form of questions and difficulty level. The Achievement Test was prepared on the basis of Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001) . The copy of Achievement test is given in the Appendix III.

Steps involved in the construction of an achievement test are discussed below:

Planning of the test

A one hour test was planned for maximum of 30 marks. Achievement Test in Mathematics was conducted for Eighth standard students on the unit "Ratio". Since, the experimental study was conducted on the sample of students of Malayalam medium, test was also planned by considering Malayalam as medium of instruction.

Preparation of a design

The investigator developed a design of the test. Due weightage was given to content, thinking skills, form of questions and difficulty level of questions. The details of each are given below.

Design for Achievement Test

The design of achievement test was given weightage to content, weightage to thinking skills, weightage to form of questions and weightage to difficulty level.

Weightage to content

The weightage given for the subtopics of the content is given in Table 2.

Table 2

Weightage to Content

Sl. No.	Topic	Learning Outcomes	Marks	Percentage
1	Part relations	*To understand the concept of ratio *To internalize the idea of times and part	13	43.33
2	Changing relations	*To practice the method of finding the ratio between two quantities	5	16.67
3	Three quantities	*To find the ratio between three quantities *To understand the concept of proportion between two quantities	12	40
Total			30	100

Weightage to Thinking Skills

The weightage given to thinking skills are given in Table 3.

Table 3

Weightage to Thinking Skills

Sl No:	Category	Mark	Percentage
1	Remembering	7	23.33
2	Understanding	6	20.00
3	Applying	5	16.66
4	Analyzing	5	16.66
5	Evaluating	2	16.66
6	Creating	5	6.66
Total		30	100

Weightage to Form of Questions

The weightage given to form of questions is given in Table 4.

Table 4

Weightage to Form of Questions

Sl No:	Form of Questions	No of questions	Marks	Percentage
1	Objective	1	5	16.66
2	Short answer	4	10	33.33
3	Essay	3	15	50
Total		8	30	100

Weightage to Difficulty Level

The weightage given to difficulty level is given in Table 5.

Table 5

Weightage to Difficulty Level

Sl No:	Difficulty Level	Marks	Percentage
1	Easy	11	36.66
2	Average	14	46.66
3	Difficult	5	16.66
	Total	30	100

Preparation of the Blue Print

Blue print was prepared as a three dimensional chart indicating the distributions of questions. The blue print gave the details of the design in concrete terms. The blue print of the achievement test in Mathematics constructed by the investigator is given in Table 6.

Table 6
Blue Print

Thinking Skills	Remembering			Understanding			Applying			Analyzing			Evaluating			Creating			
	O	S	E	O	S	E	O	S	E	O	S	E	O	S	E	O	S	E	
Form of Questions																			
Content																			
Part relations	5(1)	2(1)				3(1)													13
Changing relations																		5(1)	5
Three Quantities									5(1)		5(1)		2(1)						12
Total		7			6			5		5		2					5		30

- The numbers inside the bracket indicate the number of questions and those outside indicate the total marks for the items
- O,S,E indicates objective type test items, Short Answer type test items and Essay type test items respectively.

Writing of item

Based on the blueprint, investigator formulated eight items. Among the eight items, one item is a set of five objective type questions.. Remaining seven items include four short answer types and three essay type items.

Evaluation of the initial draft

Initial draft of the test was evaluated to make sure the questions were suiting to the thinking skills mentioned in design of the achievement test. Also, consultation was done with an expert in mathematics education for further modification. Investigator also consulted with a mathematics teacher who is teaching the students of eighth standard in Kerala state syllabus.

Modification of the items

The suggestions given by the guide and the experts were implemented by the investigator .Two items were rewritten .The items were made clear and specific.

Preparation of the final draft

After considering the suggestions and corrections from the guide and experts, the final draft was made with eight items. The achievement test was administered to the eighth standard students.

Validity of the test

“Validity refer to the degree to which evidence and theory support the interpretation of the test scores entailed by proposed uses of tests” (Joint committee on standard for Educational and Psychological Testing, 1999).

Content validity of the test was inspected by checking whether the items in the achievement test represented the purpose for which the test was meant to be. Moreover, the items were submitted to experts for their suggestions and modification and they were incorporated into the test which is also a proof of content validity.

Preparation of the scoring Key and marking scheme

In order to maintain objectivity, scoring should be made strictly in accordance with a predesigned scheme of evaluation. The investigator prepared the scoring key and marking scheme. The scoring key and marking scheme is given in Appendix IV.

Data Collection Procedure

In order to try the method using art integrated strategy in mathematics, investigator met the head master of the school and got permission for conducting a study in two divisions of 8th standard of that school. Investigator also met subject teacher in both the divisions to do this quasi experimental study in their allotted periods. The dates to teach the lessons and administer the pre-test and post –test were decided. The dates were chosen according to the

- a) Convenience of teacher and pupils
- b) Availability of periods

The procedure in which the present study was conducted comprised of three levels viz, pre-test, treatment level and post test level.

Pre-Test Level

The day for administering the pre-test was fixed with the consent of the head master and subject teacher.

The Achievement test in Mathematics required one hour for administration. The investigator administered the pretest for experimental group and control group to assess the entry behavior of the students with regard to post-test. Timing was maintained according to the time given in the question paper. At the end of the test the answer sheets were collected and then scored with respect to the scoring procedure pattern mentioned above. The raw scores were tabulated, statistically, analyzed and interpreted.

Treatment Level

After the administration of the pre-test the investigator himself taught the chapter ratio in two divisions of eighth standard. Among them, one division is considered as experimental group where art integrated strategy is used for transaction. And the other division is considered as controlled group where constructivist strategy is used for transaction of mathematics. Investigator taught same concept, same problems by following the syllabus, handbook and text book of eighth standard which follows Kerala state board curriculum in both groups. Treatments were flexible while transacting with respect to the lesson transcript formed. The photographs of activities related to Art Integrated Strategy is given in Appendix V.

Post Test Level

The day for administering achievement test as post test was fixed with consent of the head master and subject teacher. Procedures which followed while pretest was followed here too.

Scoring and Consolidation of Data

All the answer sheets of the pre-test and post-test, which were correct in all respects, were scored according to the scoring key. Scores of pre-test and post-test of control group and experimental group were tabulated separately. The scores obtained for the selected variables were then consolidated for final analysis.

Statistical Techniques Used

Statistical techniques used in the present study are given below.

Descriptive statistics

Descriptive statistics techniques like Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis are used for preliminary analysis of the data.

Test of Significance of Difference between Means (t-test)

Comparison of difference between means for the scores of sub samples was done using the formula.

$$\text{Critical ratio } t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

Where,

M_1 –Mean of the first group

M_2 –Mean of the second group

σ_1^2 –Square of Standard deviation of first group

σ_2^2 –Square of Standard deviation of second group

N_1 –Size of the first group

N_2 - Size of the second group

If the obtained critical ratio is greater than the required table value 1.96 at 0.05 or 2.58 at 0.01 levels of significance, the mean difference is considered to be significant.

3. Analysis of Covariance (ANCOVA)

This is an extension of analysis of variance to allow for the correlation between critical and final scores. Through covariance analysis, it is able to effect adjustments in final or terminal scores which will allow for differences in some initial variable.

The procedure of one way ANCOVA is done through the following steps

Step 1 :

Computation of correlation terms (c,s) C_x , C_y and C_{xy} .

Step 2 :

Computation of sums of squares (ss) among the means of the group.

Step 3 :

Computation of sums of squares (ss) within the group.

Ss within groups for x=Total ssx-ss among means for x

Ss within groups for y=Total ssy-ss among means for y

Ss within groups for xy=Total ssxy-ss among means for xy

Step 4:

A preliminary analysis of variance of x and y scores, taken separately is calculated to decide whether the scores are closer to significance. The F-test applied to the initial score.

Step 5:

Computation of adjusted sum of squares (ss for y ie, SS).

This is done for correcting the final score. Total SSyx are determined. SSyx among mean is calculated by subtracting sum of squares, we can compute the variance by dividing each SS by its degree of freedom.

Step 6:

Computation of regression coefficient for within group.

Step 7:

Computation of adjusted means: the general formula is

$$t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

Where,

M_y is the adjusted means for y scores

M_x is the unadjusted means for x scores

GM_x is the grand means for x scores

Step 8:

The testing of significance of difference among adjusted y means.

For this standard error of the difference between tow mean is calculated.

Then t-value is calculated.

$T = \text{Difference between adjusted mean} / \text{standard error of the difference between means.}$

ANALYSIS AND INTERPRETATION

- *Objectives of the Study*
- *Hypotheses of the Study*
- *Preliminary Analysis*
- *Major Analysis*

ANALYSIS AND INTERPRETATION

Data collection is systematic recording of information. Data analysis involves working to uncover patterns and trends in data sets; data interpretation involves explaining those patterns and trends. Analysis and interpretation of data collected are the two essential steps in the process of research. The data gathered through the administration of the tools or any other means need to be systematized, organized and then analyzed in order to determine the inherent meaning.

Analysis of data is the heart of research report. A plan of analysis should be prepared in advanced before the actual collection of material. Analysis is a process which enters into research in one form or another in the very beginning. It may be fair to say that research consist of general of two larger steps gathering of data, the analysis of these data. Analysis of data, studying the organized materials in order to determine inherent facts or meaning ,requires an alert, flexible and open mind. No similarities difference, trends and outstanding factors should go unnoticed, larger division of material should broken down into smaller units and rearranged in new combination to discover new factors and relationship. Data should be studied from many angles as possible to find out new and never facts.

The purpose of the present study was to develop art integrated strategy to transact mathematics among secondary school students and to check the effectiveness of art integrated strategy compared to constructivist strategy on

achievement in mathematics. The analysis and interpretation of data is described under the following headings:

- Objectives of the study
- Hypothesis of the study
- Preliminary Analysis
- Major Analysis

Objectives of the Study

The objectives of the study are as follows;

1. To compare the mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. To compare the mean of post-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
3. To find out whether there exist any significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental group and control group.
4. To find out the effectiveness of Art integrated strategy on Achievement in Mathematics of secondary school students.

Hypotheses of the Study

The hypotheses formulated for the present study are:

1. There exists no significant difference in mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. There exists significant difference in mean post-test scores of Achievement in Mathematics of secondary school students in experimental and control group.
3. There exists significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental and control group.
4. Art integrated strategy will be effective for enhancing achievement in Mathematics of secondary school students.

Preliminary Analysis

The important statistical properties of the scores of the dependent variable under study for control group and experimental group were analyzed as a preliminary step. The mean, median, mode, standard deviation, skewness and kurtosis of Achievement in Mathematics were calculated for the pre-test, post-test and gain scores of experimental and control group.

The statistical constants for the pre-test, post-test and gains scores like mean, median, mode, standard deviation, kurtosis and skewness for experimental group is given in Table 7.

Table 7

Statistical constants for Achievement in Mathematics for experimental group

Statistical constants	Pre-test score	Post-test score	Gain score
Mean	7.43	16.2	8.77
Median	4	16	8
Mode	1	9	8
Standard Deviation	7.03	7.28	3.63
Skewness	0.931	0.12	1.10
Kurtosis	-0.456	-1.425	2.306

Table 7 shows that for the pre-test scores the value of mean, median and mode are 7.43, 4 and 1 respectively for the experimental group. The values of mean and median are almost equal. The obtained value of skewness is 0.931 which indicates that the distribution is positively skewed. The value of kurtosis is -0.456 which indicates that the distribution is leptokurtic in nature.

For the post-test scores, the Table 7 shows that the value of mean, median and mode are 16.2, 16 and 9 respectively for the experimental group. The values of mean and median are almost equal. The obtained value of skewness is 0.12 which indicates that the distribution is positively skewed. The value of kurtosis is -1.425 which indicates that the distribution is leptokurtic in nature.

For the gain scores, the Table 7 shows that the value of mean, median and mode are 8.77,8 and 8 respectively for the experimental group. The values of mean, median and mode are almost equal. The obtained value of skewness is 1.10 which indicates that the distribution is positively skewed. The value of kurtosis is 2.306 which indicate that the distribution is slightly platykurtic in nature.

The statistical constants for Achievement in Mathematics of pre-test,post-test and gain scores of control group are given in Table 8.

Table 8

Statistical Constants for Achievement in Mathematics for control groups

Statistical constants	Pre-test score	Post-test score	Gain score
Mean	3.94	11.98	8.05
Median	3	11	7.25
Mode	3	5	11
Standard Deviation	3.98	6.85	4.12
Skewness	1.497	0.676	0.288
Kurtosis	1.76	-0.475	-0.856

Table 8 shows that for the pre-test scores the value of mean, median and mode are 3.94,3 and 3 respectively for the control group. The values of mean and median are almost equal. The obtained value of skewness is 1.497 which indicates that the distribution is positively skewed. The value of kurtosis is 1.76 which indicates that the distribution is platykurtic in nature.

For the post-test scores, the Table 8 shows that the value of mean, median and mode are 11.98, 11 and 5 respectively for the control group. The values of mean and median are almost equal. The obtained value of skewness is 0.676 which indicates that the distribution is positively skewed. The value of kurtosis is -0.475 which indicates that the distribution is leptokurtic in nature.

For the gain scores, the Table 8 shows that the value of mean, median and mode are 8.05, 7.25 and 11 respectively for the control group. The values of mean, median and mode are almost equal. The obtained value of skewness is 0.288 which indicates that the distribution is positively skewed. The value of kurtosis is -0.857 which indicate that the distribution is platykurtic in nature.

Major Analysis

After the preliminary analysis, the data was subjected to further statistical analysis. The test of significance of differences between means was used to compare the pre-test, post-test and gain scores of Achievement in Mathematics of Experimental group and Control group. The details are presented as follows:

1. Comparison of pre-test scores of Achievement in Mathematics of experimental and control groups.
2. Comparison of post-test scores of Achievement in Mathematics for experimental and control groups.
3. Comparison of gain scores of Achievement in Mathematics of experimental and controlled group.

Comparison of Pre-test scores of Achievement in Mathematics of the experimental and control groups

The Achievement in Mathematics of the Experimental and control group was measured before the treatment by using Achievement test in Mathematics. A comparison of means scores of pre-test scores for Achievement in Mathematics was done. The data and results of the test of significance of difference between the pre-test scores of Achievement test in Mathematics for experimental and control groups is given in Table 9.

Table 9

Data and Results of the Test of Significance of Difference between the Mean Pre-Test Scores of Achievement in Mathematics for the Experimental and Control Groups

Variable (Pre-test)	Mean	S.D	t-value	Level of Significance
1. Control group	3.94	3.98	2.53	0.05
2. Experimental group	7.43	7.03		

From the Table 9, it is evident that the t-value obtained for pre-test scores of experimental and control group is 2.53 which is significant at 0.05 level. This shows there exists significant difference between the means of the pre-test scores of achievement in Mathematics for the experimental and control groups. The experimental group performed better than the control group in pre-test scores of Achievement in Mathematics at secondary level.

Comparison of Post-test scores of Achievement in Mathematics of the experimental and control groups

The Achievement in Mathematics of the experimental and control group was measured after the treatment by using Achievement test in Mathematics. A comparison of means scores of post-test for Achievement in Mathematics was done. The data and results of the test of significance of difference between the post-test scores of Achievement test in Mathematics for experimental and control groups in given Table 10.

Table 10

Data and Results of the Test of Significance of Difference between the Mean Post test Scores of Achievement in Mathematics for the Experimental and Control Groups

Variable (Post-test)	Mean	S.D	CR	Level of Significance
1. Control group	11.98	6.85	2.44	0.05
2. Experimental group	16.2	7.28		

From the Table 10, it is evident that the t-value obtained for post-test scores of Experimental and control group is 2.44 which is significant at 0.05 level. This shows there exists significant difference between the means of the post-test scores of achievement in Mathematics for the experimental and control groups. The experimental group performed better than the control group in post-test scores of Achievement in Mathematics at secondary level.

Comparison of Gain scores of Achievement in Mathematics of the experimental and controlled groups.

The Achievement in Mathematics of the experimental and control group was measured before and after the treatment by using Achievement test in Mathematics. Gain scores were calculated by finding the difference in the measures of pre-test and post-test. An analysis of mean gain scores for Achievement in Mathematics was done. The data and results of the test of significance of difference between the gain scores of Achievement test in Mathematics for experimental and control groups in given Table 11.

Table 11

Data and Results of the Test of Significance of Difference between the Mean Gain Scores of Achievement in Mathematics for the Experimental and Control groups

Variable (Pre-test)	Mean	S.D	CR	Level of Significance
1. Control group	8.05	4.12	0.76	NS
2. Experimental group	8.77	3.63		

From the Table 11, it is evident that the t-value obtained for gain scores of experimental and control group is 0.76 which is not significant at any level. This shows there is no significant difference between the means of the gain scores of achievement in Mathematics for the experimental and control groups. It is not possible to declare that the experimental group performed better than the control group in gain scores of Achievement in Mathematics at secondary level.

The above three tables were helpful to understand changes in achievement of students in both the groups. By taking the means of pre-test and post-test scores of both experimental and controlled group, achievements of students were analyzed using test of significance of difference between means.

Analysis of Covariance

The analysis of the pre-test scores of the experimental and control groups showed that they do not differ significantly in the achievement of mathematics. After the experimental treatment was given, it was found that experimental group was better than the control group on achievement in Mathematics. The greater post-test scores of the pupils in the experimental group than that of the pupils in the control group cannot be attributed to the application of the experimental variables to the experiment group. In this context it became necessary to analyse the data using the statistical technique called Analysis of co-variance (ANCOVA) by which the difference in pre-test scores of the two groups can be removed statistically, that they can be compared as though their initial status had been equated.

The summary of single factor ANCOVA for gain scores in achievement as dependent variables with pre-test scores as covariate which is given in Table 12.

Table 12

A Summary of ANCOVA for Gain Scores of Experimental and Control Group

Source	Type III sum of squares	Df	Mean square	F	Sig
Group	6.168	1	6.168		
Error	972.932	64	15.202	.406	NS
Total	5739.25	67			

The obtained F ratio was tested for significance. The table value of ratio for df (1, 66) is 4 at 0.05 level of significance. The table 12 shows that the obtained F ratio is 0.406 which is not significant at any level of significance. When the observation is made after means of gain scores have been adjusted, it is found that the means of gain scores of pupils in the experimental and control groups for Achievement in Mathematics do not differ significantly. The result obtained through test of significance of difference between means of gain scores also supports this result.

Conclusion

The present study displays that art integrated strategy cannot be declared as a strategy effective than constructivist strategy on Achievement in Mathematics. This study also shows that there exists a significant difference between experimental group and control group on Achievement in Mathematics after treatment is applied. Hence, Art Integrated Strategy can be used for teaching mathematics provided more care is taken to improve the achievement of students.

**SUMMARY, FINDINGS,
CONCLUSION AND
SUGGESTIONS**

- *Study in Retrospect*
- *Variables of the study*
- *Objectives of the study*
- *Hypotheses of the study*
- *Methodology of the study*
- *Major Findings*
- *Tenability of Hypotheses*
- *Conclusions*
- *Educational Implication*
- *Suggestions for Further Research*

SUMMARY, FINDINGS, CONCLUSION AND SUGGESTIONS

This chapter gives a brief summary of the study including a short description of the study in retrospect. This is followed by a description of major findings, conclusions and implications that can be derived from the present study. Further, suggestions for future research are also included in this chapter.

Study in Retrospect

The present study is entitled as: “EFFECTIVENESS OF ART INTEGRATED STRATEGY ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS”.

Variables of the Study

The experimental study consists mainly of two types of variable viz. the independent variable and dependent variable. The independent variable and dependent variable selected for the study are described below:

Independent variable

The Independent variable used in the study is ‘Art Integrated Strategy’.

Dependent variable

Achievement in Mathematics was taken as the dependent variable for the present study.

Objectives of the Study

The objectives of the study are as follows;

1. To compare the mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. To compare the mean of post-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
3. To find out whether there exist any significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental group and control group.
4. To find out the effectiveness of Art integrated strategy on Achievement in Mathematics of secondary school students.

Hypotheses of the Study

The hypotheses formulated for the present study are:

1. There exists no significant difference in mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.
2. There exists significant difference in mean post-test scores of Achievement in Mathematics of secondary school students in experimental and control group.

3. There exists significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental and control group.
4. Art integrated strategy will be effective for enhancing achievement in Mathematics of secondary school students.

Methodology of the Study

Methodology deals with the precise description of method used to realize the objectives of the study. The present study used experimental method. The methodology used for the present study is described as follows:

Design of the study

The present study adopted quasi experimental design to compare the effectiveness of art integrated strategy and constructive strategy on Achievement in Mathematics. The pre-test post-test non equivalent group design was used for the study. The notion is given below:

G1 O1 X O2

G2 O3 C O4

Where G1 is the experimental group with pre-test O1 and post-test O2 and G2 is the control group with pre- test O3 and post-test O4.

Sample

The population consists of secondary school students studying in standard VIII who follows Kerala State syllabus. The sample selected for the study comprised of 67 students of VIII standard in two classes of C.M.M.H.S.S.Thalakkulathur, Kozhikode District. Experimental group is comprised of 35 students and control group comprised of 32 Students.

Tools Used for Data Collection

The tools used for data collection by the investigator for the present study are:

1. Lesson transcripts in Art integrated strategy.
2. Lesson transcripts in Constructivist format.
3. Achievement test in Mathematics.

Statistical Techniques Used

The collected data were analyzed by using the following statistical techniques.

- Descriptive statistics.
- Test of significance of difference between means(t-test)
- Analysis of Covariance (ANCOVA)

Major Findings

1. There exists significance difference in the pretest scores of experimental and control groups. ($t = 2.53$).
2. There exists significant difference in the post test scores of experimental and control groups. ($t = 2.44$)
2. There exists no significant difference between the mean gain scores of experimental and control group. ($t = 0.76$)
4. The obtained F value is not significant for gain scores of Achievement in Mathematics ($F = .406$) when pretest scores are made covariant. Hence, there exists no significant difference in gain scores between the experimental and control group.

Tenability of Hypothesis

Hypothesis 1 “There exists no significant difference in mean pre-test scores of Achievement in Mathematics of secondary school students in experimental group and control group.”

The t-value obtained for the test of significance of the difference between the means of pre-test scores of Achievement in Mathematics for experimental and control group is 2.53. This result shows that there exists significant difference between the experimental and control group in their initial status at 0.05 level. Hence, the **Hypothesis is rejected**.

Hypothesis 2 “There exists significant difference in mean post-test scores of Achievement in Mathematics of secondary school students in experimental and control group.”

The t-value obtained for the test of significance of the difference between the means of post-test scores of Achievement in Mathematics for experimental and control group is 2.44. This result shows that there exists significant difference between the experimental and control group in their post test scores at 0.05 level. Thus, the **Hypothesis is accepted.**

Hypothesis 3 “There exists significant difference in mean gain scores of Achievement in Mathematics of secondary school students in experimental and control group.”

The t-value obtained for the test of significance of the difference between the means of gain scores of Achievement in Mathematics for experimental and control group is 0.76. This result shows that there is no significant difference between the experimental and control group in their gain scores at any level. Hence, the **Hypothesis is rejected.**

Hypothesis 4 “Art integrated strategy will be effective for enhancing achievement in Mathematics of secondary school students.”

The F-value obtained, after fixing pre-test scores as covariant, for means of gain scores of Achievement in Mathematics for experimental and control group using Analysis of Covariance is 0.406 . This result shows that there is no significant

difference between the experimental and control group in their gain scores at any level. . Hence, the **Hypothesis is rejected.**

Conclusions

After comparing the mean scores of pretest in experimental and control groups, investigator observed that there exists significant difference in mean pre-test scores of achievement in Mathematics between experimental and control groups. That is, the distribution of subjects in groups was in non equivalent form. Thus, study took place in a non equivalent design.

In the comparison between the mean post-scores of experimental and control group, it is observed that there exists significant difference between the scores. Here, experimental group got greater mean score than control group which is statistically significant.

It is observed that there exists no significant difference between the means of gain scores of both groups. That is, even though the average score of experimental group is greater than that of control group, the difference in gain is not statistically significant. Hence, it is not possible to declare that the strategy used in experimental group is effective than that of the control group or vice versa.

The present study was an attempt to understand the outcome of an innovative teaching learning strategy in which various art forms are incorporated in teaching Mathematics. From the vision of making it as a regular teaching strategy in the schools of Kerala, investigator tried to design it as a practically comfortable, formal strategy which can be used for teaching Mathematics. Concept of this strategy is the

resultant of the concepts behind art integrated experimental schools practiced in West, the schools of thoughts behind art integration, the ideas of integrating art in regular academic classroom content and art education. Art integrated strategy practiced for this investigation is a positive indication for the all above thoughts to evolve more. Because, the improvement of achievement in mathematics of the experimental group is proving it as a concept which is worth to work out better. Also, post test scores of achievement is statistically significant between both the groups. Even though mean gain scores are not statistically significant between the groups, mean gain scores of experimental group is bit greater than that of controlled group. This, indicate the possibility of improving the strategy for understanding the further scope of it.

But, when the observation with respect to the main objective of effectiveness of Art Integrated Strategy on achievement, it is evident that art integrated strategy cannot be declared as a strategy better than constructivist strategy in the aspect of effectiveness on achievement in Mathematics. Since, the investigator choose constructivist method in control group to compare the effectiveness of achievement in Mathematics at secondary schools, conclusion has to be made based on the scientific and evolved format of constructivism practiced in Kerala. Constructivist strategy is more flexible in many ways even to incorporate unique ideas from other strategies.

The lack of experience of the investigator in designing and executing new strategy also might have lead to the rejection of the third hypotheses. Lack of exam oriented perspective in the art integrated design might also have resulted in

the above result. Investigator could have been improved the lesson plan design in art integrated strategy with respect to the nature of the subject mathematics in secondary school level.

Thus, it can be concluded that:

- Art Integrated Strategy can be used for transacting Mathematics in Secondary school level.
- Art Integrated Strategy cannot be declared as a strategy which is effective than constructivist strategy on achievement in Mathematics among secondary school students.

Educational Implication of the Study

1. While incorporating any innovative teaching method using art forms, teaching community must be very much keen on rectifying the faults of it before executing.
2. A meditative effort is needed to design an art integrated strategy in mathematics to include all the levels of problems as per objectives of the curriculum.
3. Enormous possibilities are there to include art forms in transacting the mathematics curricular content to learners.
4. Various innovative methods can be formed to understand and solve problems in mathematics using art integrated strategy.

5. Educational Environment must be very much suitable for executing art integrated strategy in terms of infrastructure and background facilities.
6. Art education for content transaction and art integrated strategy are the areas worth to be developed in educational field if necessary patience is given.
7. Every art form is carrying a passive teaching strategy in it. In any subject, this could be used for transaction and improved till become an effective strategy by practicing and researching.
8. While implementing any strategy using art forms, curricular planners must make sure that, it is helpful in improving the achievement too in every sense including academics.
9. Curriculum planners, educational experts and mathematics teachers have to be aware about the genuineness of the content in mathematics to design more suitable activities in art integrated strategy.
10. Art integrated strategy has lot of possibilities in creating changes in the social and emotional development of learners along with academic improvement.
11. Practicing art integrated strategy in an educational environment may lead to modification of behavior in all aspects of learners including team spirit, communication, imagination, co-operation, self reflection, creativity, appreciating the academic content and inter-dependence.

12. More suitable art integrated academic activities may be included in the constructivist teaching practices.

Suggestions for Further Research

1. Effectiveness of art integrated strategy on attitude towards mathematics can be checked as an experimental study
2. Effectiveness of art integrated strategy on interest towards learning mathematics can be checked as an experimental study.
3. Art Integrated strategy can be developed further using more innovative methods by rectifying the present design can be implemented and experimented by various teachers to check the effectiveness on achievement.
4. Effectiveness of art integrated strategy on various aspects can be checked in other subjects like Physical Sciences, Social Sciences, Natural Sciences, Languages and Commerce.
5. Similar study can be extended to other districts.
6. Effectiveness of this strategy can be investigated in cultivating values, social skills, Communication skills, presentation skills and creating general awareness about issues like environmental, gender justice ,traffic rules and health.
7. Each art forms can be analyzed qualitatively and practically to identify more suitable method for presenting unique concepts.

8. Designing of an innovative teacher education strategy to cultivate genuine awareness about art integrated strategy among teachers can be attempted in mathematics and all other subjects.
9. A qualitative study can be conducted to analyse the aspects of art integrated learning environment which reflects its inclusive nature.
10. Effectiveness of art integrated strategy on achievement, interest and attitude in various academic disciplines among differently abled children can be checked.
11. A study can be conducted to understand and analyse the art integrated academic activities from the view of constructivism.

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APPENDICES

APPENDIX I
FAROOK TRAINING COLLEGE
Lesson Transcript on Art Integrated Strategy

Mrs. Niranjana K.P
Assistant Professor

Arjun R.S
M.Ed Student

Name of the teacher :	Arjun R.S	Std :	VIII
Name of the school :	CMMHSS, Thalakkulathur	Div :	C
Unit :	അംശബന്ധം	Date :	11.11.2016
Topic :	ബീജഗണിത രൂപത്തിൽ അംശബന്ധം കാണുന്ന രീതി	Duration:	40 mnts.

Learning Objectives

- ❖ അംശബന്ധം എന്ന ആശയം ബീജഗണിത രൂപത്തിൽ അവതരിപ്പിക്കുന്നതിന്
- ❖ ഗണിതാശയങ്ങൾ (ഭാഗങ്ങളുടെ ബന്ധം) സ്വതന്ത്രമായി അവതരിപ്പിക്കാനുള്ള ആശയവിനിമയശേഷി ഉറപ്പാക്കിയെടുക്കുന്നതിന്.
- ❖ ഗണിതത്തെ (ഭാഗങ്ങളുടെ ബന്ധം) എന്ന ആശയത്തെ രസകരമായി സമീപിക്കുന്നതിന്.
- ❖ മിമിക്രിയിലൂടെ ആശയങ്ങൾ ഗ്രഹിക്കാൻ പരിശീലിക്കുന്നതിന്.

Art Forms used

മിമിക്രി, ഡ്രോയിംഗ്, പെയിന്റിംഗ്, സംഭാഷണം എഴുതൽ.

Materials Required

പെൻസിൽ, കളർബോക്സ്

Pre requisites

- മടങ്ങ്, ഭാഗം എന്നിവയെക്കുറിച്ചുള്ള അറിവ്

- മടങ്ങ്, ഭാഗം എന്നിവ ഉപയോഗിച്ച് അംശബന്ധം കാണാനുള്ള അറിവ്
- ചതുരത്തിന്റെ ചുറ്റളവ് കാണാനുള്ള അറിവ്

Activity I

കഴിഞ്ഞ ക്ലാസ്സിൽ നൽകിയ തുടർപ്രവർത്തനങ്ങൾ ചെയ്തോ എന്ന് അധ്യാപകൻ അന്വേഷിക്കുന്നു. അതിനെക്കുറിച്ച് ചർച്ചചെയ്യുന്നു. തുടർന്ന് താഴെ വിശദീകരിക്കുന്ന പ്രവർത്തനം ക്ലാസിൽ ചെയ്യുന്നു.

രണ്ട് വ്യത്യസ്ത ശബ്ദങ്ങളുപയോഗിച്ച്, മിമിക്രിയിലൂടെ അധ്യാപകൻ അംശബന്ധം എന്ന ആശയം ബീജഗണിതരൂപത്തിൽ അവതരിപ്പിക്കുന്നു.

അധ്യാപകൻ വി.എസ് അച്യുതാനന്ദന്റെ ശബ്ദത്തിലും ഒരു മുത്തശ്ശിയുടെ ശബ്ദത്തിലും രണ്ട് അളവുകളുടെയും മൂന്ന് അളവുകളുടെയും അംശബന്ധം ബീജഗണിതം ഉപയോഗിച്ച് എങ്ങനെ കൈമാറ്റം ചെയ്യാം അവതരിപ്പിക്കുന്നു.

മിമിക്രി

വി.എസ് അച്യുതാനന്ദന്റെ ശബ്ദത്തിൽ:

‘രണ്ട് ഉവുകൾ തമ്മിലുള്ള അംശബന്ധം $a:b$ ആണെങ്കിൽ ആദ്യത്തെ അളവ് ax ഉം രണ്ടാമത്തെ അളവ് bx ഉം ആകുന്ന x എന്നൊരു അളവുണ്ട്.’

തുടർന്ന് $a:b$ എന്നതിന് പകരം $3:2$ എന്നും $5:3$ എന്നും സംഭാഷണം മാറ്റിപ്പറയുന്നു. കുട്ടികളോട് അവർക്ക് അനുകരിക്കാൻ കഴിയുന്ന ശബ്ദത്തിൽ സംഭാഷണങ്ങൾ അവതരിപ്പിക്കാൻ പറയുന്നു.

x ന്റെ വില ഏതൊക്കെ വരാമെന്ന് ചർച്ചചെയ്യുന്നു. x ന് 5, 10, 20 എന്നീ വിലകൾ നൽകി അളവുകളുടെ മാറ്റം തിരിച്ചറിയാൻ കുട്ടികളോട് ആവശ്യപ്പെടുന്നു.

മുത്തശ്ശിയുടെ ശബ്ദത്തിൽ:

‘മൂന്നളവുകൾ തമ്മിലുള്ള അംശബന്ധം $a:b:c$ ആണെങ്കിൽ ആദ്യത്തെ അളവ് ax ഉം രണ്ടാമത്തെ അളവ് bx ഉം മൂന്നാമത്തെ അളവ് cx ഉം ആകുന്ന x എന്നൊരു അളവുണ്ട്.’

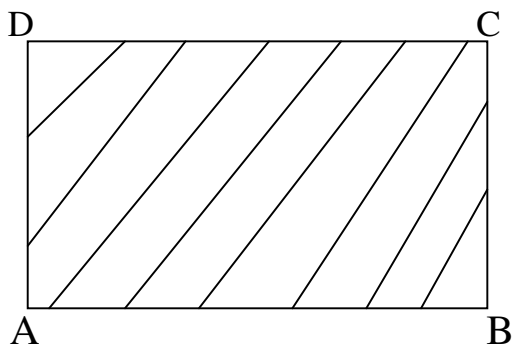
തുടർന്ന് $a:b:c$ എന്നതിന് പകരം $3:2:4$ എന്നും $5:3:2$ എന്നും സംഭാഷണം മാറ്റിപ്പറയുന്നു. കുട്ടികളോട് അവർക്ക് അനുകരിക്കാൻ കഴിയുന്ന ശബ്ദത്തിൽ സംഭാഷണങ്ങൾ അവതരിപ്പിക്കാൻ പറയുന്നു.

x ന്റെ വില ഏതൊക്കെ വരാമെന്ന് ചർച്ചചെയ്യുന്നു. x ന് 5, 10, 20 എന്നീ വിലകൾ നൽകി അളവുകളുടെ മാറ്റം തിരിച്ചറിയാൻ കുട്ടികളോട് ആവശ്യപ്പെടുന്നു.

പലതരത്തിലുള്ള ശബ്ദങ്ങളിലൂടെ മുകളിലെ രണ്ട് ആശയങ്ങളും സംഖ്യകളുപയോഗിച്ചും അല്ലാതെയും മിമിക്രിയിലൂടെ അവതരിപ്പിക്കാൻ പ്രോത്സാഹിപ്പിക്കുന്നു. മിമിക്രി അവതരിപ്പിക്കാൻ താൽപര്യമില്ലാത്ത കുട്ടികളോട് സംഭാഷണം എഴുതാൻ ആവശ്യപ്പെടുന്നു.

Activity 2

കുട്ടികളെ ഗ്രൂപ്പുകളായി തിരിച്ചശേഷം താഴെ നൽകിയ ചിത്രമടങ്ങുന്ന ഒരു ചർച്ചാസൂചകം ഓരോ ഗ്രൂപ്പിനും നൽകുന്നു.



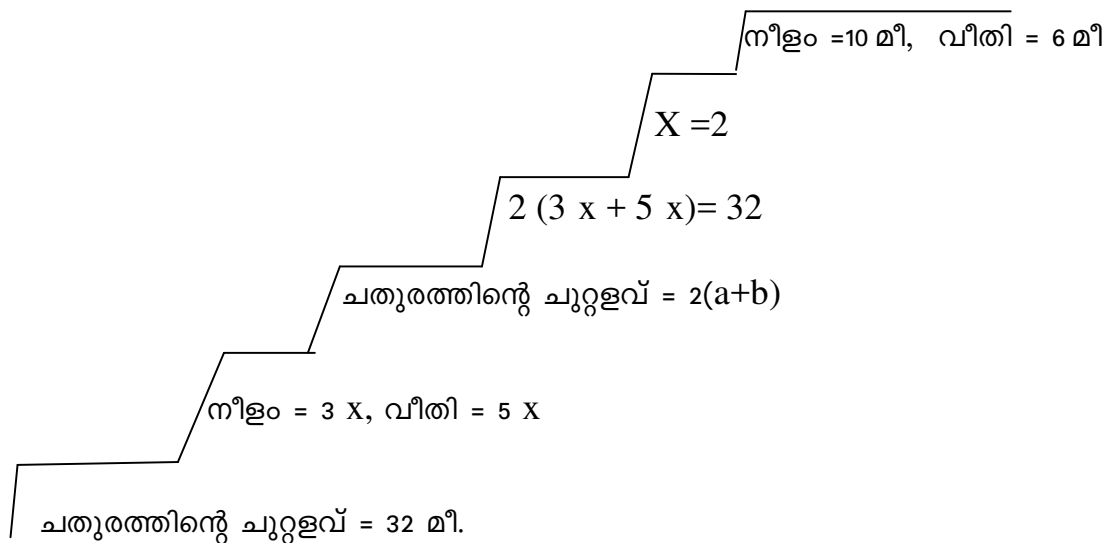
9 cm വീതിയും 15 cm നീളവും ഉള്ള ചതുരം ചുവന്ന നിറത്തിൽ ഷേഡ് ചെയ്തിരിക്കുന്നു. കുട്ടികളെ ഗ്രൂപ്പുകളാക്കി തിരിച്ച് ഓരോ ഗ്രൂപ്പിനും ആ ചിത്രം നൽകി മറ്റൊരു നിറത്തിൽ ഇതേ ചിത്രം വരയ്ക്കാൻ പറയുന്നു. തുടർന്ന് വരച്ച ചിത്രത്തിന്റെ നീളം, വീതി, ചുറ്റളവ്, വശങ്ങൾ തമ്മിലുള്ള അംശബന്ധം എന്നിവ കെ ത്താൻ പറയുന്നു.

തുടർന്ന് താഴെ കാണുന്ന ചോദ്യം ചോദിക്കുന്നു.

“32 മീറ്റർ ചുറ്റളവുള്ള ഒരു ചതുരത്തിന്റെ നീളവും വീതിയും 3:5 എന്ന അംശബന്ധത്തിലാണ്. വീതിയും നീളവും എത്ര മീറ്ററാണ്. ?”

3:5 എന്ന അംശബന്ധമാണെങ്കിൽ നീളവും വീതിയും എത്രയാണെന്നും (ഉത്തരം; $3x$, $5x$) ചതുരത്തിന്റെ ചുറ്റളവിന്റെ സമവാക്യം എന്താണെന്നും ചോദിക്കുന്നു. തുടർന്ന് അംശബന്ധവും ചതുരത്തിന്റെ ചുറ്റളവും ഉപയോഗിച്ച് x ന്റെ വിലയും ചതുരത്തിന്റെ നീളവും വീതിയും കെ ത്താനുള്ള സൂചനകൾ നൽകുന്നു. ക്ലാസ്സിലെ സാഹചര്യത്തിനനുസരിച്ച് ഗ്രൂപ്പായോ വ്യക്തിപരമായോ പ്രവർത്തനങ്ങൾ നൽകാൻ നിർദ്ദേശം നൽകുന്നു.

തുടർന്ന് ഉത്തരങ്ങൾ ഒരു പടിയുടെ ആകൃതിയിലോ കുന്നിന്റെ ആകൃതിയിലോ വരച്ച് നിറം നൽകാൻ നിർദ്ദേശിക്കുന്നു.



Follow up Activity

ഒരു സമബഹുഭുജത്തിന്റെ അകകോണിന്റെയും പുറംകോണിന്റെയും അളവുകൾ തമ്മിലുള്ള അംശബന്ധം 7:2 ആണ്. ഓരോ കോണും എത്രയാണ്. ?

ഈ ബഹുഭുജത്തിന് എത്ര വശങ്ങളുണ്ട്.

കിട്ടിയ ഉത്തരത്തെ ഇഷ്ടമുള്ളൊരു രൂപത്തിൽ വരച്ച് നിറം നൽകുക. (ഉദാ: വെള്ള ചുട്ടം, തോട്)

APPENDIX II

FAROOK TRAINING COLLEGE

Lesson Transcript on Constructivist Format

Mrs. Niranjana K.P
Assistant Professor

Arjun R.S
M.Ed Student

Preliminary Details

Name of the teacher : Arjun R.S	Name of the school : CMMHSS Thalakkulathur
Subject : Mathematics	Standard : VIII
Age group : 12-13	Strength : 32
Unit : അംശബന്ധം	Duration : 40 mnts.
Topic : ഭാഗങ്ങളുടെ ബന്ധം	Date : 09.11.2016

Content Analysis

Terms

അംശബന്ധം, ഭാഗം, മടങ്ങ്

Facts

ഒരു നിശ്ചിത ഏകകം ഉപയോഗിച്ച് നീളം അളക്കുമ്പോൾ എപ്പോഴും എണ്ണൽ സംഖ്യ കിട്ടണമെന്നില്ല.

Concepts

ഒരു നീളത്തെ അഞ്ച് സമഭാഗങ്ങളാക്കി, ആദ്യത്തെ മൂന്ന് സമഭാഗങ്ങളെ AB എന്നും, പിന്നീടുള്ള സമഭാഗങ്ങളെ BC എന്നും വിളിക്കുകയാണെങ്കിൽ AB, AC യുടെ $\frac{3}{5}$ ഭാഗവും BC, AC യുടെ $\frac{2}{5}$ ഭാഗവും ആണ്.

Principle

$x_1 : x_2 = y_1 : y_2$ ആണെങ്കിൽ $x_1 = ky_1$, ഉം $x_2 = ky_2$ ഉം ആയിരിക്കും.

Learning Outcomes

Short term outcome

$\frac{1}{x}$, $x \neq 0$, $\frac{1}{y}$, $y \neq 0$ എന്നീ സംഖ്യാ രൂപങ്ങൾ തമ്മിലുള്ള അംശബന്ധം കൈമാറുന്നതിന്.

Long term outcome

നിശ്ചിത ഏകകത്തിന്റെ അടിസ്ഥാനത്തിൽ അംശബന്ധം കൈമാറുന്നതിന്

Process Skills

- ഗ്രൂപ്പ് പ്രവർത്തനശേഷി.
- അളവുകളെ പ്രായോഗികമായി ഗണിതരൂപത്തിൽ മനസ്സിലാക്കൽ.

Prerequisites

- ഭിന്നസംഖ്യകളെക്കുറിച്ചുള്ള അറിവ്.
- നീളം അളക്കുന്ന രീതികൾ

Resources

- ചാർട്ട്, ഇൗർക്കിലുകൾ, സാധാരണക്ലാസ്റൂം ഉപകരണങ്ങൾ.

Process	Product
<p>Introductory Activity</p> <p>കഴിഞ്ഞ ക്ലാസിൽ നൽകിയ കണക്കുകൾ ചെയ്തോ എന്ന് അധ്യാപകൻ അന്വേഷിക്കുന്നു. തുടർന്ന് കഴിഞ്ഞ ക്ലാസിൽ പഠിച്ച കാര്യങ്ങളും ചർച്ച ചെയ്ത ആശയങ്ങളും ഒന്നുകൂടി വിശദമാക്കുന്നു. തുടർന്ന് ഇന്ന് നാം $\frac{1}{x}$ എന്ന രൂപത്തിൽ എഴുതുന്ന സംഖ്യകളുടെ അംശബന്ധത്തെക്കുറിച്ചാണ്</p>	

പഠിക്കുന്നത് എന്നറിയിക്കുന്നു. ഈർക്കിലുകൾ കിട്ടില്ലേ എന്ന് ചോദിച്ച ശേഷം ഇന്ന് നാം ഈർക്കിലുകൾ ഉപയോഗിച്ചാണ് പ്രവർത്തനങ്ങൾ നടത്തുന്നത് എന്നറിയിക്കുന്നു.

Group Activity

കുട്ടികളെ 6 ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ഓരോ ഗ്രൂപ്പിനും 30 സെ.മീ നീളമുള്ള ഒരു ഈർക്കിൽ, 5 സെ.മീ നീളമുള്ള ഒരു ഈർക്കിൽ, 10 സെ.മീ, 15 സെ.മീ നീളമുള്ള രണ്ട് വരകളുള്ള ഒരു പേപ്പർ എന്നിവ നൽകുന്നു. തുടർന്ന് താഴെ കാണുന്ന ചോദ്യങ്ങൾക്ക് അളന്ന് ഉത്തരം കാണാൻ ആവശ്യപ്പെടുന്നു.

- 1) വലിയ വര വലിയ ഈർക്കിലിന്റെ എത്ര ഭാഗമാണ്?
- 2) ചെറിയ വര വലിയ ഈർക്കിലിന്റെ എത്രഭാഗമാണ്?
- 3) ചെറിയ ഈർക്കിൽ വലിയ ഈർക്കിലിന്റെ എത്ര ഭാഗമാണ്?
- 4) വലിയ വര അളക്കാൻ ചെറിയ ഈർക്കിൽ എത്ര തവണ ഉപയോഗിക്കേണ്ടി വരും? ചെറിയ വര അളക്കാനോ? (ഈ ചോദ്യങ്ങൾ ഒരു ചർച്ചാസൂചകത്തിൽ നൽകുന്നു)

Individual Activity

നാലാമത്തെ ചോദ്യത്തിൽ വലിയ വരയിൽ മൂന്ന് തവണയും ചെറിയ വരയിൽ 2 തവണയും ചെറിയ ഈർക്കിൽ വെയ്ക്കണമെന്ന് കൂടു. വലിയ വര വലിയ ഈർക്കിലിന്റെ $\frac{1}{2}$ ഭാഗവും ചെറിയ വര വലിയ ഈർക്കിലിന്റെ $\frac{1}{3}$ ഭാഗവും ആണെന്ന് ചർച്ചാസൂചകത്തിലെ 1, 2 ചോദ്യങ്ങളെ അടിസ്ഥാനമാക്കി വിശദീകരിക്കുന്നു. തുടർന്ന് $\frac{1}{2}, \frac{1}{3}$ എന്നീ സംഖ്യകളെ ഏത് സംഖ്യകൊണ്ട് ഗുണിച്ചാൽ അവ എണ്ണൽ സംഖ്യകളാകും എന്ന് കണ്ടെത്താൻ പറയുന്നു. അത്തരത്തിൽ ഗുണിച്ച ശേഷം കിട്ടു

ന്ന ഏറ്റവും ചെറിയ ജോഡി എണ്ണൽ സംഖ്യകൾ ഏതാണെന്ന് ക്കെ
 ത്താനും പറയുന്നു. തുടർന്ന് 3, 2 എന്നിവ ഗുണിക്കാനും അപ്പോൾ കിട്ടു
 ന്ന ഉത്തരവും ചർച്ചാ സൂചകത്തിലെ മൂന്നാമത്തെ ചോദ്യത്തിലെ ഉത്തര
 ത്തിന്റെ ഷേദവും താരതമ്യം ചെയ്യാൻ ആവശ്യപ്പെടുന്നു. തുടർന്ന്
 ചെറിയ ഇൗർക്കിൽ വലിയ ഇൗർക്കിലിന്റെ $\frac{1}{6}$ ഭാഗമാണെന്ന് പറയുന്നു.
 ചെറിയ ഇൗർക്കിൽ ഏകകമായി എടുത്താൽ വലിയ വരയുടെയും ചെറി
 യ വരയുടെയും നീളങ്ങൾ തമ്മിലുള്ള അംശബന്ധം 3:2 ആകുന്നത് കൃ
 ത്യമായി വിശദമാക്കുന്നു.

Individual Activity

Consolidated Activity

ഈ പ്രവർത്തനത്തിൽ നിന്ന്

ഒരു നീളം ഒരു പൊതുനീളത്തിന്റെ $\frac{1}{2}$ ഉം രാമത്തെ നീളം
 അതേ പൊതുനീളത്തിന്റെ $\frac{1}{3}$ ഉം ആണെങ്കിൽ ആ രാമ നീളങ്ങൾ തമ്മി
 ലുള്ള അംശബന്ധം 3:2 ആയിരിക്കുമെന്ന് മനസ്സിലാക്കാമെന്ന് വിശദീകരി
 ക്കുന്നു.

$$\frac{1}{2} : \frac{1}{3} = \frac{1}{2} \times 6 : \frac{1}{3} \times 6$$

$$= 3:2$$

എന്ന് എഴുതാമെന്ന് അറിയിക്കുന്നു.

‘ഒരു വടിയുടെ നീളത്തിന്റെ $\frac{1}{5}$ ഭാഗം നീളമുള്ള നൂലും $\frac{1}{2}$ ഭാഗം നീളമു
 ള്ള നൂലും തമ്മിലുള്ള അംശബന്ധം എത്ര?’ എന്ന ചോദ്യം നൽകുകയും
 ആവശ്യമെങ്കിൽ ഉത്തരത്തിലെത്താൻ വേ സൂചനകൾ നൽകുകയും
 ചെയ്യുന്നു. (ഉദാ: 2 ന്റേയും 5 ന്റേയും ല.സ.ഗു)

Follow up Activity

ഒരു നൂൽ ഒരു സ്കെയിലിന്റെ $\frac{1}{5}$ ഉം മറ്റൊരു നൂൽ അതേ സ്കെയിലിന്റെ $\frac{1}{3}$ ഉം ആണെങ്കിൽ ഒന്നാമത്തെ നൂലും രണ്ടാമത്തെ നൂലും തമ്മിലുള്ള അംശബന്ധം എന്താണ്?

APPENDIX III
FAROOK TRAINING COLLEGE
Achievement Test in Mathematics

Mrs. Niranjana K.P
Assistant Professor

Arjun R.S
M.Ed Student

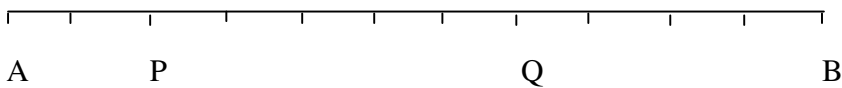
നിർദ്ദേശങ്ങൾ

- എല്ലാ ചോദ്യങ്ങളും വായിച്ച് മനസ്സിലാക്കിയ ശേഷം മാത്രം ഉത്തരം എഴുതുക.
 - ആവശ്യമുള്ളിടത്ത് ഉത്തരത്തിൽ എത്തിച്ചേരുന്നതിനുള്ള വിശദീകരണം നൽകുക.
-

STD: VIII

Time : 1 Hr.

1. 72 മീറ്റർ ചുറ്റളവുള്ള പാടത്തിന്റെ നീളവും വീതിയും 5:4 എന്ന അംശബന്ധത്തിലാണ്. ചതുരത്തിന്റെ വിസ്തീർണ്ണമെത്ര? (3)
2. ചുവപ്പും പച്ചയും ചായങ്ങൾ 6:5 എന്ന അംശബന്ധത്തിൽ കലർത്തി പുതിയ നിറമുണ്ടാക്കി. പച്ചച്ചായത്തേക്കാൾ 4 ലിറ്റർ കൂടുതലാണ് ചുവപ്പ് ചായം. ഓരോന്നും എത്ര ലിറ്ററാണ് എടുത്തത്? (3)
3. മൂന്ന് പാൽസംഭരണികളുടെ ഉള്ളളവ് തമ്മിലുള്ള അംശബന്ധം 2:3:5 ഏറ്റവും ചെറുതിൽ 120 ലിറ്റർ പാൽ കൊള്ളും. മറ്റ് രണ്ട് ഏതെങ്കിലും ഏതെങ്കിലും എത്ര ലിറ്റർ പാൽ കൊള്ളും? (5)
4. A B എന്ന വരയെ പതിനൊന്ന് സമഭാഗങ്ങളാക്കിയിരിക്കുന്നു



- 1) AB യുടെ ----- ഭാഗമാണ് AP
- 2) PQ, QB യുടെ ----- മടങ്ങാണ്.
- 3) AP യുടെ 5 മടങ്ങും PQ യുടെ ----- മടങ്ങും തുല്യമാണ്.
- 4) -----ന്റെ 2 മടങ്ങ് QB യ്ക്ക് തുല്യമാണ്.
- 5) AP യുടെ $\frac{1}{2}$ ഭാഗവും PQ യുടെ $\frac{1}{5}$ ഭാഗവും QB യുടെ ----- ഭാഗവും തുല്യമാണ്. (5)
5. രണ്ട് എണ്ണൽ സംഖ്യകൾ തമ്മിലുള്ള അംശബന്ധം 3:7 ആണ്. ഒരു സംഖ്യ 15 ആണെങ്കിൽ രണ്ടാമത്തെ സംഖ്യ ഏത്? (2)
6. ഒരു ത്രികോണത്തിലെ വശങ്ങൾ തമ്മിലുള്ള അംശബന്ധം 3:5:6 ആണ്. ത്രികോണത്തിന്റെ ചുറ്റളവ് 42cm ആണ്. ത്രികോണത്തിലെ ഏതെങ്കിലും ഒരു വശത്തിന്റെ നീളം നിലനിർത്തിക്കൊണ്ട് മറ്റ് വശങ്ങളുടെ അംശബന്ധം 3:4:5 ആകുന്ന രീതിയിലുള്ള ത്രികോണം നിർമ്മിക്കുക? (5)
7. ഒരു പെട്ടിയിൽ മൂന്ന് നിറത്തിലുള്ള മുത്തുകളുണ്ട്. അതിൽ കറുത്ത മുത്തുകളുടെയും വെളുത്ത മുത്തുകളുടെയും എണ്ണം തമ്മിലുള്ള അംശബന്ധം 3:5 ഉം വെളുത്ത മുത്തുകളുടെയും ചുവന്ന മുത്തുകളുടെയും എണ്ണം തമ്മിലുള്ള അംശബന്ധം 2:3 ഉം ആണ്. മൂന്നുനിറത്തിലുള്ള മുത്തുകളുടെയും എണ്ണം തമ്മിലുള്ള അംശബന്ധം എന്താണ്? (5)
8. ഏതെങ്കിലും ത്രികോണത്തിന്റെ വശങ്ങൾ തമ്മിലുള്ള അംശബന്ധം 2:5:7 ആകുമോ? എന്തുകൊണ്ട്? (2)

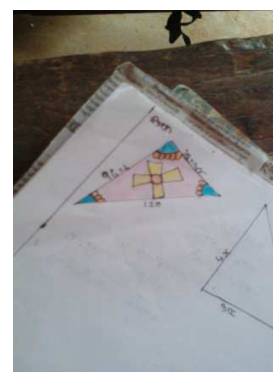
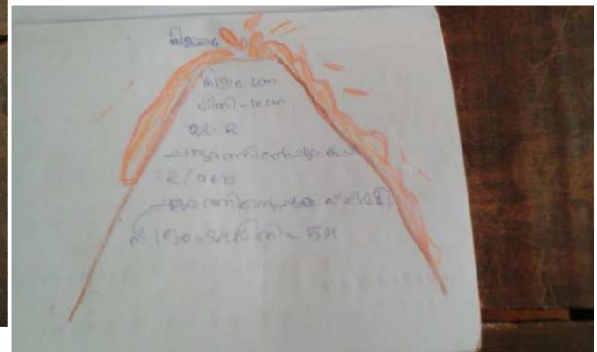
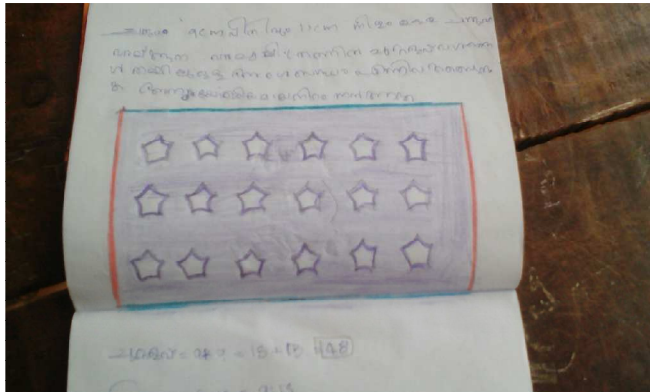
APPENDIX IV
FAROOK TRAINING COLLEGE
Scoring key and Marking scheme

Question No.	Value points	Score	Total score
1	<p>പാടത്തിന്റെ നീളം = 5x പാടത്തിന്റെ വീതി = 4x</p> <p>ചതുരത്തിന്റെ ചുറ്റളവ് = 2 (നീളം + വീതി)</p> <p>2 (നീളം + വീതി) = 72 മീ.</p> <p>2(5x + 4x) = 72 മീ. 18x = 72 x = 4</p> <p>നീളം = 20 മീ. വീതി = 16 മീ.</p> <p>വിസ്തീർണ്ണം = നീളം ത വീതി = 20 X 16 = 320 m²</p>	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p>	3
2	<p>ചുവപ്പ് ചായത്തിന്റെ അളവ് = 6x പച്ച ചായത്തിന്റെ അളവ് = 5x</p> <p>6x = 5x + 4</p> <p>6x - 5x = 4</p> <p>x = 4</p> <p>ചുവപ്പ് ചായത്തിന്റെ അളവ് = 24 ലി. പച്ച ചായത്തിന്റെ അളവ് = 20 ലി.</p>	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p>	3
3	<p>പാൽസംഭരണികളുടെ ഉള്ളളവുകൾ തമ്മിലുള്ള അംശബന്ധം = 2:3:5</p> <p>ചെറിയ പാൽസംഭരണിയിലെ അളവ് = 2x</p> <p>2x = 120</p>	<p>½</p> <p>½</p> <p>½</p>	

	$X = 60$ <p>ര റ്റമത്തെ സംഭരണിയിലെ അളവ് = $3x$</p> $= 180$ <p>മൂന്നാമത്തെ സംഭരണിയിലെ അളവ് = $5x$</p> $= 300$	$\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ 1	5
4	1) $\frac{2}{11}$ 2) $\frac{5}{4}$ 3) 2 4) AP 5) $\frac{1}{4}$	1 1 1 1 1	5
5	<p>ഒന്നാമത്തെ സംഖ്യ = $3x$</p> <p>ര റ്റമത്തെ സംഖ്യ = $7x$</p> $3x = 15$ $x = 5$ <p>ര റ്റമത്തെ സംഖ്യ = $7x$</p> $= 35$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
6	<p>ത്രീകോണത്തിന്റെ ഒന്നാമത്തെ വശം = $3x$</p> <p>ത്രീകോണത്തിന്റെ ര റ്റമത്തെ വശം = $5x$</p> <p>ത്രീകോണത്തിന്റെ മൂന്നാമത്തെ വശം = $6x$</p> <p>ത്രീകോണത്തിന്റെ ചുറ്റളവ് = $3x + 5x + 6x$</p> $3x + 5x + 6x = 42$ $14x = 42$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	5

APPENDIX V

Photographs from Art Integrated Learning Environment



Appendices

